At present, 16 APEC (Asia-Pacific Economic Cooperation forum) economies and one United Nations institution are jointly engaged in the SCF-funded "Development of Earthquake and Tsunami Disaster Mitigation Technologies and Their Integration for the Asia-Pacific Region," while UNESCO (United Nations Education, Science, and Culture Organization) and the Inter-national Union of Geological Sciences are engaged in an international cooperation project for "Cultural Assets and Forecasting of Landslide Disasters."

Building on the 1990s, which were declared the International Decade for Natural Disaster Reduction (IDNDR), in 2000 the United Nations declared the International Strategy for Disaster Reduction (ISDR), an initiative that is expected to play an active role in the field of disaster prevention science and technology

### 3.2.2.7.2 Earthquake Surveys and Research

In light of the Great Hanshin-Awaji Earthquake Disaster that occurred in 1995, the Special Measure Law on Earthquake Disaster Prevention was passed for the purpose of promoting comprehensive earthquake prevention measures all across Japan. The law stipulates the system of responsibility for earthquake surveys and research that impinge directly on administrative policies, and the Headquarters for Earthquake Research Promotion (Chairman: Minister of Education, Culture, Sports, Science and Technology) was established based on that law to facilitate these activities.

The Headquarters for Earthquake Research Promotion has established a Policy Committee and an Earthquake Research Committee consisting of staff members from relevant ministries and agencies, and from academia. Based on "The Promotion of Earthquake Research – a basic comprehensive policy for the promotion of earthquake observation, measurement, surveys and research," adopted in April 1999, the Headquarters for Earthquake Research Promotion serves as the point of contact and cooperation between relevant ministries and agencies for the promotion of earthquake surveys and research (Figure 3-2-10).

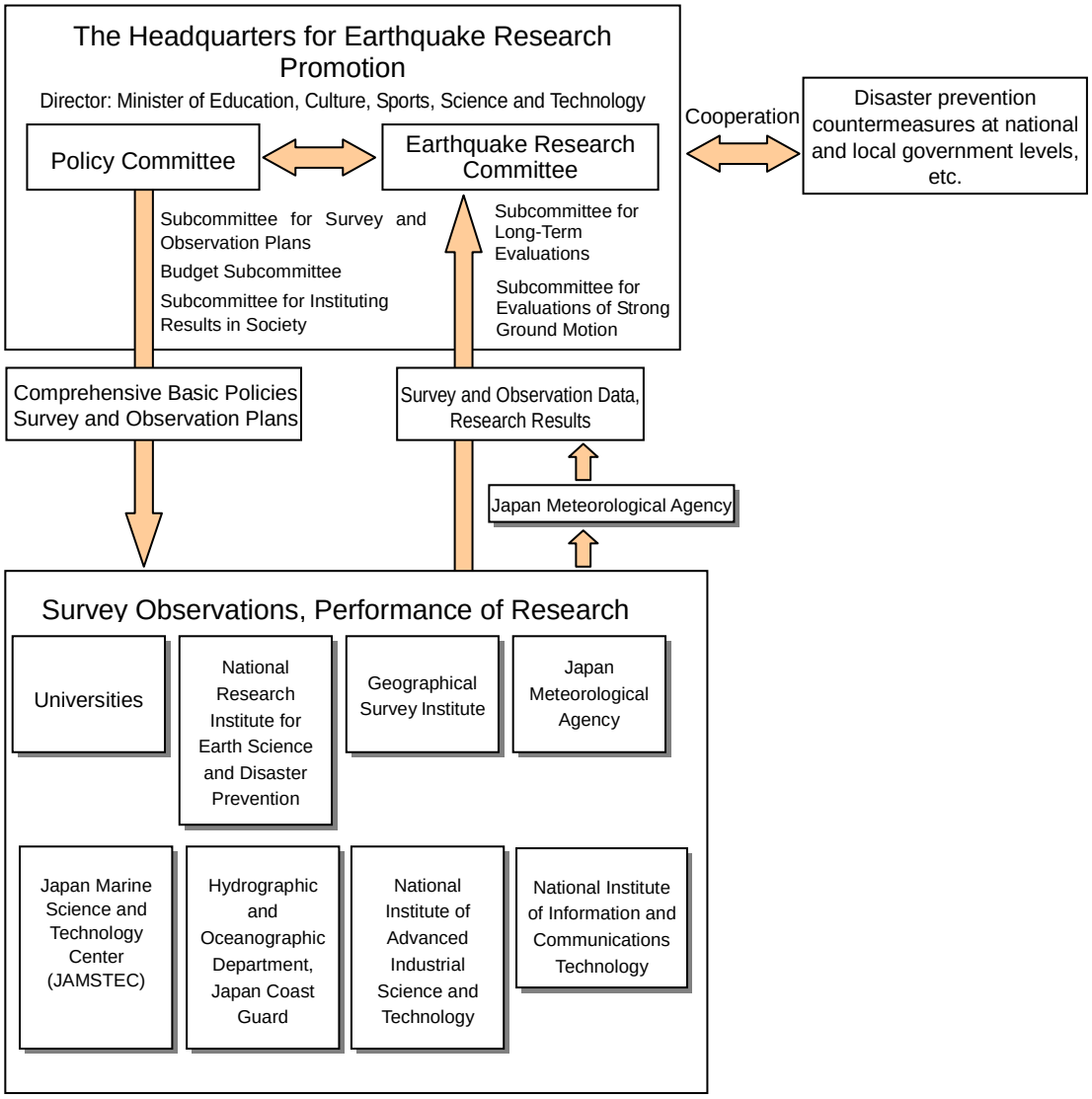


**Figure 3-2-10 The structure of the headquarters for earthquake research promotion**

The Policy Committee performs administrative adjustments of budgets related to earthquake surveys and research in the relevant ministries and agencies. In August 2003, the Headquarters adopted the "Estimate of Budget Requests Related to Earthquake Surveys and Research for FY2004," and called upon the Prime Minister and other relevant ministers to respect its content when drawing up the government budget.

In addition, the Survey and Observation Planning Subcommittee established under the Policy Committee issued the "Plan to Strengthen Surveys and Observation Targeting the Tonankai and Nankai Earthquake Regions (First-Stage Report)" in June 2003.

The Earthquake Research Committee holds regular meetings on a monthly basis, and at other times when an earthquake does particular damage. At these meetings, the committee collects comprehensive evaluations of earthquake activities in Japan

and publishes them immediately to ensure their utility in disaster prevention activities. For example, extraordinary meetings were held following the occurrences of the Miyagi Prefecture Offshore Earthquake in May 2003, the North Miyagi Prefecture Earthquake of July 2003, and the Tokachi Offshore Earthquake of September 2003, and evaluations were prepared. In addition, the Earthquake Research Committee performs a series of long-term evaluations of the probabilities of earthquake occurrence in selected active fault areas. Of the 98 fault zones listed, the committee had already published evaluation results for 48 fault zones as of February 2004. The committee has also published evaluation results regarding marine trench earthquakes, including the Nankai Trench Earthquakes (the Tonankai and Nankai Earthquakes), and the earthquake extending from the Sanriku Offshore region to the Boso Offshore region (including the Miyagi Prefecture Offshore Earthquake) (Figure 3-2-11). Furthermore, a series of strong quake motion evaluations are being conducted for some active fault zones and marine trench earthquake zones where the probability of earthquake occurrences is considered particularly high.

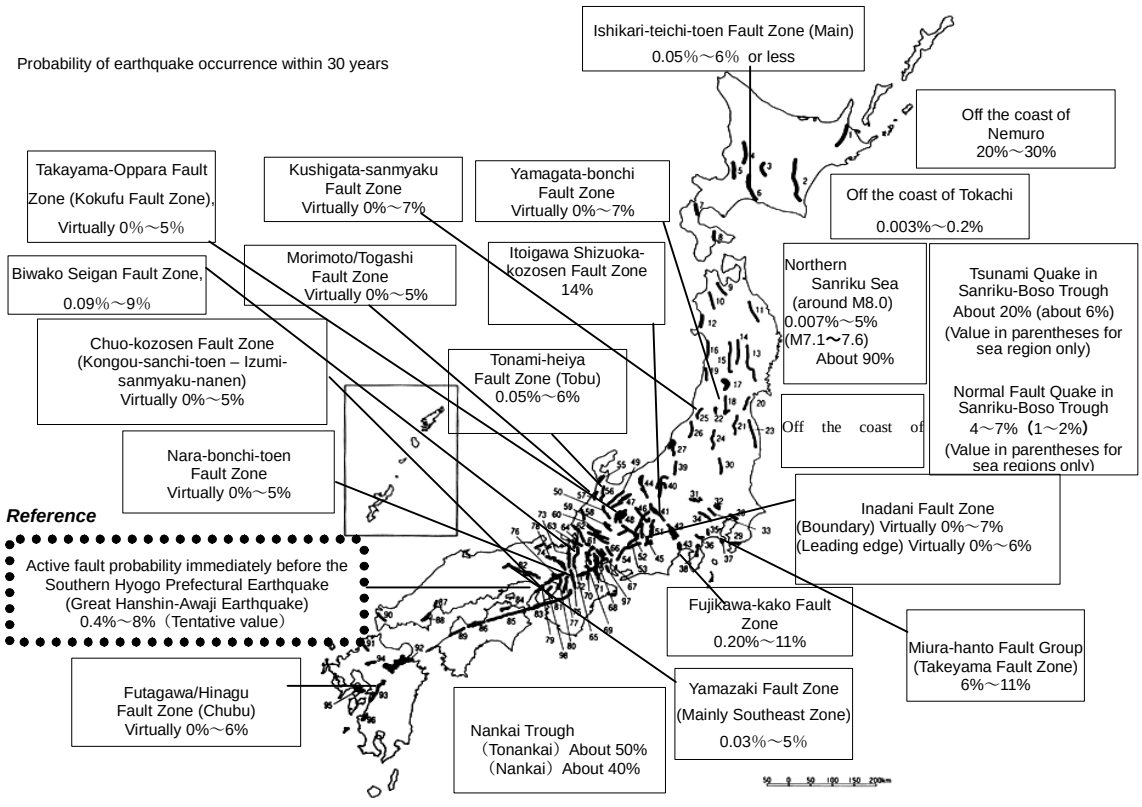


**Figure 3-2-11 Fault zones and sea areas with announced evaluation resuts**

Based on the above results, the Earthquake Research Committee is promoting the preparation of "General Seismic Hazard Maps," with the goal of covering the whole of Japan by the end of FY2004. As the first step in that process, in May 2002 the committee published a test map restricted to a region centering on Yamanashi Prefecture, followed in March 2003 with a test map limited to the Northern Japan region.

The major measures related to earthquake surveys and research in ministries and agencies are as shown in Table 3-2-12.

**Table 3-2-12 Measures for earthquake surveys and research (FY2004)**

| Ministry or agency | Research institute or program | Subject |
|---|---|---|
| Ministry of Education, Culture, Sports, Science and Technology | Research and Development Bureau | ・Basic earthquake-related survey grants<br>・Promotion of prioritized surveys and observation<br>・Regional characterization of the crust in metropolitan areas under the Special Project for Earthquake Disaster Mitigation in Urban Areas<br>・Surveys and research into Tonankai and Nankai earthquakes<br>・Project for the realization of an advanced instantaneous quake information transmission network |
| | National universities | ・Promotion of research and observation of the processes in the earth's crust leading to earthquakes<br>・Operation of geophysical observation stations |
| | Incorporated administrative agency: National Research Institute for Earth Science and Disaster Prevention | ・Development of basic survey and monitoring facilities for earthquakes<br>・Research into methods for the preparation of general seismic hazard maps |
| | Incorporated administrative agency: Japan Agency for Marine-Earth Science and Technology | ・Development and preparation of a comprehensive sea bottom network monitoring system |
| Ministry of Economy, Trade and Industry | Incorporated administrative agency: National Institute of Advanced Industrial Science and Technology | ・Research into the use of active faults and old earthquakes for quake occurrence forecasting |
| Ministry of Land, Infrastructure, and Transport | Japan Coast Guard | ・Observations for the elucidation of activities in the Earth's crust leading up to an earthquake<br>・Observations for precise monitoring activities in the Earth's crust<br>・Promotion of marine geodetic sites |
| | Japan Meteorological Agency | ・Earthquake monitoring networks, and earthquake and tsunami monitoring systems |
| | Meteorological Research Institute | ・Study to improve the accuracy of forecasting the Tokai earthquake by modeling its generation processes |
| | Geographical Survey Institute | ・Japanese archipelago precise geodetic network surveying<br>・Strengthened observation of crustal deformation<br>・Very-long baseline surveying<br>・Gravity surveys and geomagnetic surveys |

Based on the policies laid down by the Headquarters for Earthquake Research Promotion, the Ministry of Education, Culture, Sports, Science and Technology promotes surveys of active fault zones, and is also performing extended pilot survey evaluations and observations of regions where the

probability of earthquake occurrence is considered to be high. In addition, as part of the "Special Project for Earthquake Disaster Mitigation in Urban Areas," surveys and research into the crustal structure in major metropolitan areas are being conducted, as well as research into the improvement of prediction accuracy for the Tonankai and Nankai earthquake zones. The national universities are also promoting basic research into earthquake prediction. In addition, the National Research Institute for Earth Science and Disaster Prevention, acting in accordance with the "Fundamental Seismic Survey and Observation Plan," is promoting the development of high sensitivity seismic observation stations and of wide-area earthquake observation facilities, and is also engaged in collecting data from an earthquake observation network now under development that will eventually cover the entire nation, and in processing and disseminating that data. The institute is also engaged in research into methods for the preparation of general seismic hazard maps. In addition, the Japan Marine Science and Technology Center is promoting the development of a comprehensive real time deep sea-floor observation network system.

The National Institute of Advanced Industrial Science and Technology is promoting research into the evaluation of the potential of earthquake occurrences by surveying active fault zones, etc.

The Geographical Survey Institute promotes earthquake surveys and research through GPS continuous observation at about 1,224 stations around the nation (as of the end of March 2004), and also through the use of Very Long Baseline Interferometry (VLBI) and other advanced survey technologies to monitor crustal deformation and plate motion, and then analyzes the observation data. The Japan Meteorological Agency (JMA) produces a catalog of the locations and magnitudes of earthquakes based on the integrated analysis of waveform data of JMA and other relevant institutes, and promotes the development of new observation facilities and research for earthquake prediction. Furthermore, JMA plans to start official dissemination of Earthquake Early Warnings for disaster mitigation, which is aimed at providing information on the hypocenter and magnitude of an earthquake before the arrival of the shock of earthquakes, and is engaged in cooperative research with the National Research Institute for Earth Science and Disaster Prevention for upgrading this information.

The Japan Coast Guard's Hydrographic and Oceanographic Department promotes sea area measurement, as well as earthquake surveys and research in seabed terrain and active fault areas.

Japan's research into earthquake and volcanic eruption prediction is performed based on the "New Program of Research and Observation for Earthquake Prediction" adopted in August 1998 by the Geodesy Council (since FY2001 called the Subdivision on Geodesy and Geophysics under the Council for Science and Technology), and on the "The Sixth Program for the Prediction of Volcanic Eruptions" (both programs are five-year plans lasting from FY1999 to FY2003), with universities, the National Research Institute for Earth Science and Disaster Prevention, the Japan Meteorological Agency, and other institutions proceeding in the spirit of cooperation while engaged in projects suited to their particular functions and capabilities. In July 2003, the Council for Science and Technology selected "The Second New Program of Research and Observation for Earthquake Prediction" and "The Seventh Program for Prediction of Volcanic Eruptions" as programs for promotion in the next five-year plan (FY2004 to FY2008), and presented the proposals to the Minister of Education, Culture, Sports, Science and Technology and other relevant ministers for approval.

### 3.2.2.7.3 Aviation Science and Technology

R&D in aviation science and technology is knowledge-intensive and makes use of advanced technologies. As a result, developments in this field are not limited to air transport, but can also spill

over into many other sectors, and the field can be expected to play an important role in Japan's future development as a nation of creative science and technology.

In Japan, technology has accumulated through the independent development of the YS-11 commercial transport aircraft and other projects, international joint development of the Boeing 777 and other aircraft, and international joint development of the V2500 jet engine for commercial aircraft. The nation's technology is steadily increasing its role in the world's aviation industry. In particular, Japan's application of composite materials and other advanced materials in its structural design and manufacturing technologies is recognized as top-class around the world.

To actively promote the development of aircraft and their engines, it is necessary to improve the technological level still more. To this end, at the Ministry of Education, Culture, Sports, Science and Technology, the Council for Science and Technology's Aeronautical Science and Technology Committee settled on the "Promotion Policy for Research and Development into Aerospace Science and Technology" in FY2003. In addition, at the Ministry of Economy, Trade and Industry, the Industrial Structure Council's Aircraft and Space Industry Committee's Aircraft Subcommittee is holding discussions on the possibility of joint international development of civil aviation aircraft and engines, and on other directions in aircraft industry policy.

The Japan Aerospace Exploration Agency is placing priority promotion, based on the above promotion policy, on R&D that can contribute to the development of a domestic aircraft and domestic jet engine, and on R&D into transportation safety and environmental protection.

Elsewhere, the agency is promoting research into aviation safety and environmentally compatible technologies, and into fundamental technologies for computer-based numerical simulations. The agency also develops wind tunnels, engine testing facilities, and other large-scale testing and research facilities, encouraging their joint use by other institutions, to play a leading role in improving the level of aviation science and technology in Japan.

The Ministry of Economy, Trade and Industry is engaged in the research and development of "propulsion systems for environmentally suitable next-generation supersonic transporters" in response to the environmental needs of the next generation. Major aircraft engine manufacturers from Europe and the United States are also participating in this research and development. Elsewhere, the ministry is promoting the development of "technologies for manufacturing and processing of next-generation structural parts and materials" expected to be utilized in aircraft and other equipment, the development of design, manufacturing, and basic technologies related to "innovative lightweight structures," and the development of technologies related to engine structures and materials based on "MGC (Melt-Growth Composite) materials," as well as the development of technologies related to cockpit and piloting systems and other "advanced aircraft systems."

The Electronic Navigation Research Institute, an independent administrative institution for the Ministry of Land, Infrastructure and Transport, has been conducting research in the field of navigation and air traffic control systems to improve air traffic safety. This research is expected to be important for the further advancement of air transportation.

### 3.2.2.7.4 Development of Other Social Infrastructure

Society as a whole is becoming increasingly complex, with advancing urbanization and the general improvement of society through the development of transport, shipping, and communications systems, etc. On the other hand, however, rural communities face problems of population outflow and aging, reduced vitality in industry and society, a decline in public transport and shipping functions, and a general multifaceted decline in such important functions as land conservation, water source cultivation, and conservation of the natural environment. Moreover, in order to achieve a higher

quality for people's lives, where leisure and prosperity can be experienced, the development of the socio-economic infrastructure has come to be demanded.

In this sector, a number of documents have established priorities for the promotion of research and development, including the "Basic Plan for the Ministry of Land, Infrastructure and Transport Technology," adopted in November 2003 by the Ministry of Land, Infrastructure, and Transport, the "Basic Plan for Research and Development in Information and Telecommunications," adopted in February 2000 by the Ministry of Posts and Telecommunications' Council for

Telecommunications Technology (Ministry of Internal Affairs and Communications), and the "Items Related to Pollution Prevention that Require Experimental Research Priority," adopted in April 2003 by the Ministry of the Environment.

Specifically, the Ministry of Land, Infrastructure and Transport and other ministries and agencies are promoting comprehensive land use through the development of advanced national land use management technology, and research and development into disaster prevention evaluations and countermeasure technologies in city renewal projects, and into other local disaster prevention activities. The ministry is also promoting research and development into technologies for a superconducting magnetically levitated train, and of other advanced transport and shipping systems.

The Ministry of Internal Affairs and Communications and other ministries and agencies are promoting research and development into ultra-high speed network technologies, advanced information resource transmission and accumulation technologies, and other advanced information and communication systems.

In addition, the Ministry of Agriculture, Forestry and Fisheries is engaged in the development of technologies for the restoration and improvement of agriculture, forestry, and fisheries ecologies, and of methods for managing drainage basin environments.

The Ministry of Economy, Trade and Industry promotes research and development of "human lifestyle engineering for quality life" for the development of universal design products and systems.

The Ministry of Land, Infrastructure and Transport offers subsidies and other support for the Railway Technical Research Institute to promote research and development toward the practical realization of a superconducting magnetically levitated train, for the objective of high-speed transport in the future. In addition, publication of the "Development Vision for Technologies Related to Deep Underground Use" has served to promote the development of technologies with broad general applications for projects that require traversal of the deep underground. Furthermore, guidelines for ensuring safety in public use of the deep underground, and guidelines for protection of the environment, were issued in February 2004, and technology research and development is now being promoted for utilization of the deep underground that takes safety and environment into consideration.

The major research topics in FY2003 for socio-economic infrastructure, safety assurance, etc., are as shown in Tables 3-2-13 and 3-2-14.

## Table 3-2-13 Major research subjects in the improvement of the socioeconomic foundation area (FY2003)

| Ministry or agency | Research institute or program | Subject |
|---|---|---|
| Ministry of Internal Affairs and Communications | Incorporated administrative agency: National Institute of Information and Communications | · Research into basic information and communication technologies |
| Ministry of Education, Culture, Sports, Science and Technology | Incorporated administrative agency: Japan Aerospace Exploration Agency | · Technologies for higher performance domestic passenger aircraft<br>· Research into aviation safety and environment protection technologies |
| Ministry of Agriculture, Forestry and Fisheries | Incorporated administrative agency: National Institute for Rural Engineering | · Development of eco-friendly management technology for water and agro-forested-aqua-ecosystems in watershed and estuary areas |
| Ministry of Economy, Trade and Industry | | · Supersonic transport propulsion system<br>· Behavior-based human environment creation technology |
| Ministry of Land, Infrastructure, and Transport | Construction technology research and development | · Development of housing technology for a sustainable society and safe environment<br>· Development of technology for urban infrastructure management |
| | Subsidy for the development of railway technologies | · Development of a superconducting magnetically levitated train |
| | Grants-in-aid for advanced research on ship technology funding | · Research and development into ultra-large floating ocean structures |
| | National Institute for Land and Infrastructure Management | · Research into the development of knowledge-sharing methods in construction projects<br>· Research into measures for the effective utilization and activation of social infrastructure stock<br>· Research for the International Harmonization of Building Codes and Standards<br>· Research into the development of sand and dirt motion models for coherent sand flow systems<br>· Research into airport pavement design and repair to accommodate ultra-large air-craft loads that take life-cycle costs into account |
| | Geographical Survey Institute | · Development of the technology to use precise three-dimensional spatial data for the regeneration of cities |
| | Incorporated administrative agency: Public Works Research Institute | · Research on improving the durability of structures and evaluating their performance<br>· Research on evaluating the soundness of infrastructure stock and its remedial techniques<br>· Research on the efficient construction and redevelopment of dams considering the surrounding<br>· Research on reducing the construction costs of super-long highway structures |
| | Incorporated administrative agency: Port and Airport Research Institute | · Research into improving the reliability of harbor structures through the development of high-quality monitoring systems using intelligent materials |
| | Incorporated administrative agency: National Maritime Research Institute | · Research into more advanced distribution simulations |
| Ministry of the Environment | Research Funding to the National Research Institute engaged in Environmental Pollution Research | · Comprehensive research on waste disposal and the recycling of wastes<br>· Comprehensive research on advanced treatments for effluents |

**Table 3-2-14 Major research subjects in the safety area (FY2003)**

| Ministry or agency | Research institute or program | Subject |
|---|---|---|
| Ministry of Internal Affairs and Communications | Incorporated administrative agency: National Research Institute of Fire and Disaster | · Advancement of firefighting, emergency services and rescue techniques<br>· Safety measures for those who need help during disasters, such as elderly people<br>· Safety evaluation for hazardous materials and facilities handling hazardous materials |
| Ministry of Health, Labour and Welfare | Incorporated administrative agency: National Institute of Industrial Safety | · Research into the advancement of the safety technologies related to the development of comprehensive safety control measures for production and construction systems |
| Ministry of Agriculture, Forestry and Fisheries | | · Research into the prevention of accidents involving capsizing fishing boats |
| Ministry of Economy, Trade and Industry | | · Development of technologies for the safe management of liquefied petroleum gas supplies |

## 3.2.2.8 Frontier Science

Frontier science is positioned in the Basic Plan as fundamental to the nation's existence, and an area in which it is essential for Japan to be involved. The Promotion Strategies by Sector stipulate the following areas and items as meriting priority:

1. Assurance of safety
   (1) Information-gathering technology using satellites (including transportation capability)
   (2) Advanced positioning and survey technology
2. Technology innovations aimed at pioneering world markets
   (1) Low-cost, reliable transportation technology
   (2) Next-generation satellite technology
   (3) Technology for the utilization of marine resources
3. International contributions to human intellectual creation, and assurance of international position
   (1) International projects that give people, and particularly the next generation, dreams, hope, and pride
   (2) Construction of a worldwide network for global environmental information

### 3.2.2.8.1 Space Development and Utilization

Space development and utilization is extremely important because it uses the acquisition of commonly applicable knowledge regarding the origin of the universe and various phenomena about the Earth to "accumulate intellectual properties common to all humankind," and also because the expanded use of space contributes to the "expansion of the socioeconomic infrastructure" through communications and broadcasting, weather forecasting, and global environment and disaster monitoring, and to "pioneering advanced technologies" that might result in the creation of new technologies in various fields and of new industries with high added value.

Since the successful launch of Japan's first "Ohsumi" satellite in 1970, Japan has successfully launched 103 satellites as of the end of-March 2004, ranking third in the number of satellites launched behind the United States and the former Soviet Union. Table 3-2-15 shows the major satellites planned for future launch by Japan and their objectives.

## Table 3-2-15 Satellites and payloads planned to be launched

| Satellite/payload | Weight (kg) | Orbit | Orbital altitude (km) / location | Launchvehicle | Launch date (fiscal year) | Major objectives |
|---|---|---|---|---|---|---|
| ALOS<br>Advanced Land Observing Satellite | Approx. 4,000 | Sun synchronous orbit | Approx. 690 | H-IIA | 2004 | · To contribute to cartography, regional monitoring, disaster situation monitoring, resource exploration, etc. |
| LUNAR-A<br>17th scientific satellite | Approx. 540 | Orbit around the moon | Approx. 200 | M-V | 2004 | · Elucidation of crustal structure and thermal structure of the moon |
| ASTRO-E II<br>23rd scientific satellite | Approx. 1,700 | Circular orbit | Approx. 550 | M-V | 2004 | To observe X-rays from active galactic cores and galactic clusters, to elucidate the structure and evolution of space, etc. |
| ETS-VIII<br>Engineering Test Satellite-VIII | Approx. 2,800 | Geostationary orbit | - | H-IIA | 2005 | · To develop, test, and demonstrate large satellite bus and mobile satellite communications technologies, etc. |
| OICETS<br>Optical Inter-orbit Communications Engineering Test Satellite | Approx. 570 | Circular orbit | Approx. 600 | — | 2005 | · To conduct orbital tests of effective optical communications technologies in inter-satellite communications, and specifically of element technologies focusing on capture pursuit tracking |
| JEM<br>Japanese Experiment Module | Approx. 26,800 | - | Approx. 400 | U.S. Space Shuttle | 2005 to 2007 | · Expansion of Japan's space activities, promotion of leading science and technology development, and contribution to the advancement of international cooperation |
| WINDS<br>Wideband InterNetworking Engineering Test and Demonstration Satellite | Approx. 2,700 | Geostationary orbit | - | H-IIA | 2006 | · Development, etc., of ultra-fast high-capacity satellite communications technologies and other world-leading technologies |
| SELENE<br>SELenological and Engineering Explorer | Approx. 2,900 | Orbit around the moon | Approx. 100 | H-IIA | 2006 | · To research the origin and evolution of the Moon, collect data for a Moon-use feasibility survey, etc. |
| SOLAR-B<br>22nd scientific satellite | Approx. 900 | Sun synchronous orbit | Approx. 600 | M-V | 2006 | · Detailed observation of the structure and motion of micromagnetic fields on the solar surface, to elucidate the components of solar magnetism and the source of solar activity |
| GOSAT<br>Greenhouse Gas Observing Satellite | Approx. 1,500 | - | Approx. 650 | H-IIA | 2007 | · Continuous observation of physical Earth quantities, to contribute to the elucidation and forecast of global warming, climate change, changes in the ozone layer, etc. |
| GPM/DPR<br>Global Precipitation Measurement/Dual-frequency Precipitation Radar | Approx. 3,000 | - | Approx. 400 | H-IIA | 2007 | · To develop the Dual-frequency Precipitation Radar (DPR) for monitoring precipitation, as part of international cooperation in the Global Precipitation Measurement Program (GPM) |
| HTV<br>H-II Transfer Vehicle | Maximum supply weight: Approx. 7,000 | - | Approx. 350-460 | H-IIA | 2007 | · To use a Japanese transport system that can contribute a fair share of material supplies to the Space Station |
| PLANET-C<br>24th scientific satellite | Approx. 647 | Orbit around Venus | Approx. 300-79,000 | M-V | 2008 | · To explore Venus' atmosphere, and solve riddles in the basic principles of planetary weather and the evolution of atmospheres |
| ASTRO-F<br>21st scientific satellite | Approx. 960 | Sun synchronous polar orbit | Approx. 750 | M-V | No date | · To use infrared observations toward the elucidation of the formation and evolution of the Milky Way galaxy, stars, and planets |

For an overall view of Japan's space development and utilization efforts, the Council for Science and Technology Policy in June 2002 issued its "Space Development and Utilization Policy," and various ministries and agencies are promoting space development and utilization efforts based on this report. Work on a follow-up to the report began in October 2003, in the Council for Science and Technology Policy's Expert Panel on Space Development and Utilization.

In October 2003, the Ministry of Education, Culture, Sports, Science and Technology merged the three space development organizations, the Institute of Space and Astronautical Science, the National Aerospace Laboratory of Japan, and the National Space Development Agency of Japan, into a central institution for national space development, and launched it as the Japan Aerospace Exploration Agency (JAXA). For such accidents as the failure of the H-IIA No. 6 launch vehicle, JAXA commenced a complete inspection of all rockets and

satellites, to promote space development through the improvement of reliability and the prevention of a reoccurrence of such failures.

With the "Space Development and Utilization Policy" in mind, the Space Activities Commission has been engaged in discussing a long-term program of space activities, and has performed safety checks for rocket launches, and investigations into failures.

### 3.2.2.8.1.1 Space Science and Luna Exploration

JAXA plays the core role in the field of space science in Japan, launching scientific satellites with the participation of researchers from universities and colleges nationwide.

For activities in recent years, the "Hayabusa" Scientific Satellite No.20 MUSES-C was launched in May 2003, and is currently on its way to a rendezvous with an asteroid in the summer of 2005, when it will perform an engineering test for a later planned mission to take rock samples from the asteroid and return them to Earth.

The "Nozomi" Scientific Satellite No.18 PLANET-B, launched in July 1998, had a serious problem in one section of its power system that controllers were unable to resolve, and a plan to put it into orbit around Mars in December 2003 had to be abandoned. The investigation into its causes and possible improvement measures is now in progress.

Launches scheduled for FY2004 include Scientific Satellite No.17 LUNAR-A, designed for the investigation of the lunar internal structure and thermal structure, and Scientific Satellite No.23 ASTRO-E II for the observation of X-rays emitted from active galactic cores and galactic clusters, to investigate the structure and evolution of the universe.

Other projects now in development include Scientific Satellite No.21 ASTRO-F for observation in the infrared spectrum to investigate the process of the formation and evolution of galaxies, stars, and planets, Scientific Satellite No.22 SOLAR-B for detailed observation with a high degree of accuracy of the structure and motion of magnetic fields on the solar surface to investigate the origins of the solar atmosphere and the causes of solar activity, and the Moon orbiter SELENE to gather data to investigate the origins and evolution of the Moon, and to clarify the feasibility of the utilization of the Moon.

### 3.2.2.8.1.2 Communications, Broadcasting, and Positioning

Utilization of satellites for communications, broadcasting, and other purposes offers a broad range of benefits in terms of wide-area use, broadcast simultaneity, durability following disasters, etc. In Japan, the private sector is already deeply involved in satellites for the communications and broadcast sector, such as for satellite broadcasting. To further promote these private-sector efforts, the government is promoting development in advanced and basic technologies where the risks are too great for the private sector, and the development of pioneering technology for the future utilization of space.

#### (1) Wideband InterNetworking engineering test and Demonstration Satellite (WINDS)

Development is in progress in cooperation with the Ministry of Internal Affairs and Communications on the Wideband InterNetworking engineering test and Demonstration Satellite (WINDS), toward a FY2006 launch. The objectives of this ultra-high speed Internet satellite are to establish a satellite-based communications technology that enables ultra-high speed Internet and large-volume data communications, to test ultra-high speed networking technology using satellite communications, and to implement new utilization tests through cooperation between industry, academia, and government that will serve to stimulate new demand and to promote the IT revolution in Japan.

### (2) Quasi-Zenith Satellite System

The quasi-zenith satellite system would consist of multiple satellites placed in quasi zenith orbits to ensure that more than one satellite is always visible at the zenith in the skies over Japan, to achieve virtually 100% land coverage for high-quality communications, broadcasting, and positioning services, without being affected by narrow mountain valleys or tall buildings. Research into the quasi-zenith satellite system is now being promoted between the government and the private sector toward a FY2008 launch.

## 3.2.2.8.1.3 Promotion of Space Environment Utilization

The space environment offers unique characteristics for research, such as microgravity and high vacuum, that are difficult to obtain on Earth. Utilization of the space environment is expected to promote research, experiments, and observation across a broad range of fields, and to contribute to the development of society and the improvement of living conditions.

JAXA is proceeding with the development of the Japanese Experiment Module (JEM; also known as "Kibo") for the International Space Station, including a multi-user internal experiment facility (transported to the United States in FY2003) and test devices to be mounted on an exposed platform. The agency is implementing policies for the promotion of space environment utilization. A public announcement for ground-based research projects offering opportunities to researchers in a broad array of fields involved in preparation for the utilization of the space environment first began in FY1997, and that announcement is also being used as a basis for the promotion of international projects in test devices provided from various organizations for use in the International Space Station program.

Moreover, for early utilization of the space environment before launching "Kibo," JAXA is using the Russian Service Module and other platforms already operating at the International Space Station for medical experiments and public broadcasting tests using a high-definition camera, environmental durability tests for materials used in space, and the joint government-private sector "High-quality Crystalization Project on Protein Structure and Function Analyses for Practical Applications." Efforts to diversify utilization of "Kibo" are also in progress, to extend its use beyond scientific research to include activities in such sectors as education, culture and arts, and the humanities. The "Kibo Education Utilization Workshop" was held in August 2003 to focus on the use of "Kibo" for educational purposes. In July and November 2003, space education events involving interaction between children and the astronauts on the International Space Station were held.

In March 2003, the Space Activities Commission established the "Special Committee for Utilization of the International Space Station" for the purpose of studying prioritization of ISS use, and improving the efficiency of its operations and uses.

The Ministry of Economy, Trade and Industry (METI) developed a next-generation Unmanned Space Experiment Recovery System (USERS) to promote the utilization of the space environment. It was launched in September 2002 and the part of the space vehicle containing the results of the test experiments was successfully returned to Earth and retrieved on May 30, 2003. Analysis of the samples obtained in a large-scale superconducting materials crystallization growth test using a microgravity space environment is now in progress. In addition, to encourage the broad use of Japan's well-developed industrial technology in commercial satellite production processes, and to rationalize their design, procurement, and manufacture, etc., the Space Environment Reliability Verification Integrated System (SERVIS) satellite program was used to develop guidelines and necessary intellectual infrastructure for the transfer of industrial technologies to space-related devices and the use of databases of private-sector components for space-related devices, and the satellite was launched on

October 30, 2003. The private-sector components worked well in the tests, and various data is being obtained in accordance with the plan.

### 3.2.2.8.1.4 Fundamental Satellite Technology

JAXA and research institutes of related ministries and agencies are engaged in research, development and space demonstration of the new technologies and the fundamental technologies required for the support of space development and utilization activities, to ensure autonomy in space activities, and to contribute to technological innovations that spread beyond the space sector to other sectors.

#### (1) Engineering Test Satellite VIII (ETS-VIII)

Engineering Test Satellite VIII (ETS-VIII) is being developed toward aFY2005 launch for the purpose of developing large-scale geostationary satellite bus technologies, large-scale deployable antenna technologies, mobile multimedia satellite broadcast system technologies, and fundamental technologies related to satellite positioning systems utilizing high-accuracy clock standards, and for orbital demonstrations, in cooperation between JAXA and the Ministry of Internal Affairs and Communications (MIC).

#### (2) "Tsubasa" Mission Demonstration Test Satellite (MDS-1)

JAXA's "Tsubasa" Mission Demonstration Test Satellite (MDS-1), launched by the H-IIA No. 2 launch vehicle in February 2002, was intended to demonstrate the function of commercial parts in orbit, to verify the technology for shrinking the size of components, etc. (devices mounted on satellites), and to measure radiation and other space environment data. "Tsubasa" successfully completed operations in late-September 2003, obtaining in-orbit data as planned for private-sector components, as well as other data related to measurement of the space environment. The data will be used to boost the reliability of components and devices to be developed in the future.

### 3.2.2.8.1.5 Space Infrastructure

For autonomy of national space development, it is important for Japan to acquire a capability for deploying necessary materials and equipment at specific locations in space when they are needed. For this purpose, Japan is engaged in the research and development of expendable launch vehicles and reusable transport systems.

Japan is also developing an advanced inter-satellite communication technology, one of the most important requirements for supporting various activities in space, toward the acquisition of space network operations technology.

#### (1) M-V Series Rockets

For the launch of scientific payloads, the Institute of Space and Astronautical Science first developed the L (Lambda) series rockets and the M-3S2 and other M (Mu) series rockets, both of which used solid propellant for all stages, before moving on to development of the M-V rocket. The M-V rocket is capable of launching approximately 1.8 tons of payload into low orbit (Table 3-2-16), and launches No.1, No.3 and No. 5 were a success. Upon the foundation of JAXA, research and development of the M-V rocket was ended.

**Table 3-2-16 Main specification of vehicles used to launch satellites**

| Launch vehicle type | Stages | Overall length (m) | Diameter (m) | Gross weight (tons) | Propellant |
|---|---|---|---|---|---|
| M-V | 3 | Approx. 30 | 2.5 | Approx. 139 | Solid for all stages |
| H-IIA (standard) | 2 | Approx. 53 | 4.0 | Approx. 285 | 1st and 2nd stages, liquid hydrogen/oxygen; SRB-A, solid |

## (2) H-IIA Rockets

For the launching of satellites into geostationary orbit, etc., JAXA developed the N series rocket and then the H series of launch vehicles, including the H-II launch vehicle, before moving on to the H-IIA launch vehicle. The H-IIA is a two-stage rocket that uses liquid oxygen/liquid hydrogen-fueled engines for both the first and second stages (Table 3-2-16), and is capable of lifting as much as four tons of payload into geostationary transfer orbit. The launch of the H-IIA No. 1 launch vehicle in August 2001 was followed by four more successful launches that marked the transition to practical operations. However, the launch of the No. 6 vehicle, carrying information gathering satellites in November 2003, ended in failure when the solid rocket booster (SRB-A) failed to separate. An investigation into the causes of the accident is being implemented to prevent a reoccurrence, and to facilitate an early resumption of operations. Moreover the H-IIA standard type is to be transferred to the private sector in the years following FY2005, to ensure international competitiveness through the unification of manufacturing responsibility for the improvement of product quality. A basic contract for transfer was signed in February 2003 between JAXA and the private-sector entity, Mitsubishi Heavy Industries.

## (3) GX Rocket

The GX rocket is Japan's first rocket being led by the private sector in cooperation with the government, is designed to launch small and medium-size satellites, and uses liquid natural gas (LNG) for its new propellant system. Joint public-private sector research and development is now in progress toward a first launch in FY2006.

## (4) HOPE-X H-II

For the HOPE-X (H-II Orbiting Plane-Experimental), which is designed to establish the technological foundations for a reusable transport system, JAXA concluded that further studies are needed into the mode of a future reusable transport system. As a result, JAXA is conducting a review of the development results obtained to date, and is continuing to focus on R&D into elemental technologies and on the High Speed Flight Demonstration. The High Speed Flight Demonstration (Phase II) was conducted in July 2003 at the Esrange test site in northern Sweden, where flight data was successfully obtained in a flight test approaching the speed of sound. In this test, the prototype failed to land properly, and an investigation into the cause of the failure is now being performed.

## (5) Optical Inter-orbit Communications Engineering Test Satellite (OICETS)

JAXA was forced to put off the launch date for the Optical Inter-orbit Communications Engineering Test Satellite (OICETS), which was to conduct orbital experiments on the elemental technologies needed for optical communications technologies in inter-satellite communication systems, because the

European Space Agency (ESA) made a failure on the launch of the Advanced Relay and Technology Mission (ARTEMIS) geostationary satellite, which was to be a part of the joint project. Investigation of counter-measures revealed a possible solution that will allow ARTEMIS to reach the requisite orbit and perform the experiments, with the result that preparations are now in progress toward a new launch date in FY2005.

### (6) Data Relay Test Satellite (DRTS)

For the objective of performing data relay experiments between earth observing satellites and "Kibo" on the International Space Station in order to promote development of data relay functions for the Communications and Broadcasting Engineering Test Satellite (COMETS) and to accumulate experience in more advanced inter-satellite communications technology, JAXA launched the "Kodama" Data Relay Test Satellite (DRTS) on September 10, 2002 on top of the H-IIA No. 3 launch vehicle. In February 2003, DRTS successfully received wide-area Earth observation imaging data directly from the "Midori II" Advanced Earth Observing Satellite (ADEOS-II). Preparations were in progress for an inter-satellite communications test with the Advanced Land Observing Satellite (ALOS), scheduled to be launched in FY2004.

## 3.2.2.8.1.6 Fundamental and Avanced Research on Satellite and Launch Vehicle Technology

JAXA and research institutes of related ministries and agencies conduct fundamental research on launch vehicle and satellite technology. They also work in a number of advanced research areas, including for an unmanned winged reusable space vehicle and a space plane.

## 3.2.2.8.1.7 Promotion of International Cooperation in Space

With the increasing importance of observations from space by Earth observation satellites as global problems such as earth environmental problems and disasters have become more serious in recent years, and with the increasing internationalization of space activities as the society and the economy have become more globalized, the need for international cooperation in space activities is now greater than ever before. Consequently, Japan promotes cooperation with many countries, including the United States, European countries, Russia, Canada, and countries of the Asia-Pacific region in various fields.

In the area of multilateral cooperation, Japan is actively engaged in the promotion of such cooperation through the activities in the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) which discusses the international order on exploration and utilization of space, and on the promotion of international cooperation, the Asia-Pacific Regional Space Agency Forum (APRSAF) hosted by Japan, a place for exchanging opinions about the international cooperation in space development in the Asia-Pacific region, and the Committee on Earth Observation Satellites (CEOS), where technical coordination and information exchange on earth observation satellite systems is undertaken.

Japan is participating in the International Space Station (ISS) program, the largest international cooperation project in space development, by providing its own "Kibo." It is in close cooperation with all participating nations in the construction and utilization of ISS.

In the area of bilateral cooperation, cooperative space activities between Japan and the United States are proceeding smoothly under the Agreement between the Government of Japan and the Government of the United States of America concerning Cross-Waiver of Liability for Cooperation in the Exploration and Use of Space for Peaceful Purposes. For cooperation with European countries, a close relationship with the European Space Agency (ESA) is maintained through annual administrative Japan-ESA meetings. Moreover, regarding cooperation with Russia, the space cooperation agreement between the Government of the Russian Federation and the Government of Japan has been extended.

### 3.2.2.8.2 Ocean Development

The development and use of the ocean, which contains an abundance of resources, including biological and mineral resources, as well as vast space, is an important issue for a country as physically small and confined by the sea as Japan. Furthermore, because the ocean plays an important role in global environmental changes, and the movements of oceanic crusts are believed to be a major source of earthquakes and volcanic activity, elucidation of their mechanisms is urgent. In light of these conditions, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the Intergovernmental Oceanographic Commission (IOC) called for the implementation in the early 1990s of the Global Ocean Observing System (GOOS), which aims to build a system for the conduct of comprehensive observations and research of ocean phenomena on a worldwide scale. The GOOS project is now being promoted in co-operation with the World Meteorological Organization (WMO).

This plan was also incorporated into the Agenda 21 that was adopted by the United Nations Conference on Environment and Development (UNCED), also called the Earth Summit. Based on these international efforts, it is crucial for Japan to promote ocean research related to global environmental issues, and to promote other research and development into ocean sciences and technologies. Furthermore, in order to shed some light on ocean phenomena occurring on a global scale, the relevant ministries and agencies have joined with universities, etc., to actively participate in international ocean research programs such as GOOS. Also, Japan has taken a leading role in cooperation with China, South Korea, and Russia to promote the North East Asian Regional-Global Ocean Observing System (NEAR-GOOS) as a regional pilot project for GOOS.

Japan's ocean development adheres closely to the report of the Council for Science and Technology Subdivision on Ocean Development, and research and development is being promoted with the cooperation of relevant ministries and agencies according to their various situations. In "Basic Concepts and Promotion Measures for Ocean Development from the Long-Term Viewpoint (report)," subdivision responded in August 2002 to an inquiry by the Minister of Education, Culture, Sports, Science and Technology, by noting that "it is important to carefully balance knowing, protecting, and using the ocean for the policies for future ocean development when presenting strategic policies and promotion policies toward realization of sustainable utilization."

Moreover, the "Inter-Ministerial Liaison Committee for Survey of the Continental Shelf" was established in June 2002 to promote surveys for the establishment of the outer limits of the Japanese continental shelf that can be of assistance to Japan's ocean development. The liaison committee recognizes the importance to the government as a whole of firmly implementing these surveys, and that maximizing the use of scientific knowledge is important for the performance of appropriate surveys and analyses.

At the Ministry of Internal Affairs and Communication, the National Institute of Information and Communications Technology is conducting research into high-resolution three-dimensional microwave radar and shortwave ocean radar to facilitate the establishment of methods for the measurement of marine oil pollution, currents, and waves, etc., and the prediction of changes in the global environment.

At the Ministry of Education, Culture, Sports, Science, and Technology, research Institutions including the Japan Marine Science and Technology Center (JAMSTEC) are promoting advanced and basic research and development into ocean sciences and technologies. These institutions cooperate with related ministries and agencies, universities, etc., to promote comprehensive projects.

Among these projects are ongoing observational research projects in the oceans using Triton buoys and other devices, and an intensive observation voyage in FY2003 around the southern hemisphere using state-of-the-art oceanographic devices on board MIRAI, one of JAMSTEC's oceanographic research vessels, with the aim of investigating the

interactions between the atmosphere and the ocean, such as El-Nino events, as well as the effects of them on global climate change. In addition, the "SHINKAI 6500" manned submersible and the "KAIREI" deep sea research vessel were used for ocean surveys for research into the dynamics of ocean plates, and into various forms of crustal movements occurring under the sea floor. For the deep-sea Earth drilling project, construction of the "CHIKYU" deep sea drilling vessel continues to progress since its commencement in FY1999. Furthermore, the Frontier Research System for Extremophiles promoted research for the elucidation of the physiological adaptivity of deep-sea microorganisms existing in extreme environments.In addition, the University of Tokyo Ocean Research Institute is at the center of continuing ocean-related scientific research, including basic research related to GOOS for the purpose of building a comprehensive observation system for the elucidation and forecast of changes in the ocean environment, and for its preservation, participation in joint surveys of the Western Pacific region, and research into ocean flux, which can contribute to the elucidation of physical cycles in the ocean. In addition, national universities are engaged in research into marine biosystems and conducting observations of changes in the atmosphere and oceans.

The Ministry of Agriculture, Forestry and Fisheries elucidated ocean surface layer ecologies to facilitate the rational utilization and management of organic marine resources, and also elucidated the structure of deep sea ecologies and the relationship between mechanisms of change, and changes in surface layer ecologies.

At the Ministry of Economy, Trade and Industry, the Japan Oil, Gas, and Metal National Corporation (formed on February 29, 2004 from a merger and reorganization of the Metal Mining Agency of Japan and the Japan National Oil Corporation) and the National Institute of Advanced Industrial Science and Technology are at the center of continuing efforts at the development of ocean floor mineral resources and the prediction of environmental effects, and of geological surveys of the seabed.

The Ministry of Land, Infrastructure and Transport promoted research and development into next-generation coasting vessels (the Super Eco-Ship), and expanded the Nationwide Ocean Wave Information Network for Ports and Harbors (NOWPHAS) in cooperation with the Port and Airport Research Institute. The Japan Coast Guard is engaged in research into upgrading water channel measurement and marine condition monitoring technologies, and into the development of seabed monitoring technologies and upgrading of the accuracy of current flow forecasting. The Japan Meteorological Agency is continuing investigations and research toward the expansion of monitoring and forecast information for marine phenomena and climate change, including oceanographic and marine meteorological observations and elucidation of the El Niño phenomenon. Moreover, the National Maritime Research Institute is carrying out research into safety and environmental protection in the field of marine technology. In relation to the NEAR-GOOS project, the Japan Meteorological Agency and the Japan Coast Guard operate a system for promoting the exchange of oceanic data for sea regions bordering on Japan, in order to better promote oceanographic research. In addition, the Geographical Survey Institute conducts basic research of coastal sea areas for the purpose of providing the basic information needed for the formulation of comprehensive development, utilization, and protection plans for coastal sea areas.

At the Ministry of the Environment, the Global Environment Research Fund is being used to conduct research into the elucidation of the effects of pollution from the Changjiang River on marine ecosystem in the East China Sea, and on global-scale ocean pollution due to toxic substances.

Table 3-2-17 summarizes the main research subjects undertaken in the ocean sciences and technology sector by various ministries and agencies in FY2003.

## Table 3-2-17 Major research subjects in marine science and technology (FY2003)

| Ministry or agency | Research institute or program | Subject |
|---|---|---|
| Ministry of Internal Affairs and Communications | Incorporated administrative agency: National Institute of Information and Communications Technology | · Research into global environment measurement and forecasting technology, using 3-D high-resolution imaging radar |
| Ministry of Education, Culture, Sports, Science and Technology | Japan Marine Science and Technology Center | · Development of marine research technology<br>· Research and development of deep-sea research<br>· Promotion of ocean drilling in the 21st Century<br>· Frontier research<br>· Research and development of ocean utilization and marine ecosystems<br>· Research and development of ocean observation |
| | National universities and other institutions | · Ocean Drilling Program (ODP)<br>· Cooperative study of the Western Pacific (WESTPAC)<br>· Global Ocean Observing System (GOOS) |
| Ministry of Agriculture, Forestry and Fisheries | Fisheries-related research institutes | · Development of techniques for stock enhancement<br>· Development of techniques for advanced use of fishing grounds<br>· Research into the improvement and development of fishing grounds<br>· Observations of oceanographic environments related to fisheries<br>· Technological development of fishing gear and methods<br>· Measures for marine environmental conservation<br>· Research of marine space use<br>· Technological development of marine resources use |
| | | · R&D into fisheries resources |
| | Marino Forum<br>R&D into frontier technologies | · Development of artificial fishing ground technology, using deep ocean water<br>· Development of technique for predicting phytoplankton blooms responsible for paralytic shellfish poisoning<br>· Development of marine sensing technology for fisheries resource surveys |
| Ministry of Economy, Trade and Industry | Metal Mining Agency of Japan (On February 29, 2004, merged into Incorporated administrative agency: Japan Oil, Gas and Metals National Corporation) | · Research and development of deep-sea mineral resources |
| | Incorporated administrative agency: National Institute of Advanced Industrial Science and Technology | · Prediction of Earth and ocean environments based on geochemical and palaeontological research of modern and past environments |
| Ministry of Land, Infrastructure and Transport | | · Surveys for the Promotion of the fisheries in the Amami Islands |
| | Hydrographic and Oceanographic Department, Japan Coast Guard | · IOC Sub-Commission for the Western Pacific (WESTPAC) Region |
| | Japan Meteorological Agency, Meteorological Research Institute | · Study of dynamical ocean weather prediction of the Western North Pacific<br>· Development of an advanced ocean data assimilation system, and analysis from seasonal to interannual variations in the ocean |
| | Geographical Survey Institute | · Basic research of coastal sea areas |
| | Incorporated administrative agency: National Maritime Research Institute | · Research into technology for upgrading megafloats, and international<br>· Research and development into next-generation domestic route shipping (Super Ecoship) |
| | Private Sector | · R&D into very large floating structures |
| | Incorporated administrative agency: Port and Airport Research Institute | · Research into the physical environment of sand beaches<br>· Elucidation of the mechanisms for wave liquefaction and deformation of the ground, and research into countermeasure and utilization technologies<br>· Research into coastal seawater flows, and seabed environments |
| Ministry of the Environment | Research Funding to the National Research Institute engaged in Environmental Pollution Research | · Research into application of mitigation technologies to the Seto Inland Sea for creating an appropriate environment |
| | Water Maintenance Bureau | · Research into red tide |
| | Incorporated administrative agency: National Institute for Environment Studies | · Research into a methodology for evaluating the impact of the environmental load from rivers on the marine ecosystems in the Bohai and East China Seas<br>· Studies on movements of hazardous chemicals in East Asian sea regions<br>· Research into the detection of ecological changes and land-based loading effects in Asian coastal seas |
| | Global Environment Research Fund | · Research into the elucidation of the ocean's absorption of carbon dioxide from human sources in the Pacific region<br>・Iron fertilization feasibility as an option for CO2 mitigation, and its effects on marine ecosystems<br>· Research on the biogeochemical cycle in the East China Sea responding to the change in the environmental loading from land<br>· Study on the marine environmental deterioration due to N and P loadings, and silica deficiency in the global aquatic system |
| | Global Environment Research Coodination System | · Research into material databases related to carbon dioxide in the ocean, for the elucidation of oceanic carbon dioxide absorption volumes<br>· Study on the increase of sea-surface temperature in Asian monsoon regions based on coral skeletal climatology<br>· Evaluation of the effects of the oceanic segregation of carbon dioxide on the oceanic material cycling process |

### 3.2.2.9 Promotion of Science and Technology for Safety, Security, and Spiritual Enrichment

Toward realization of the goal of "a nation securing safety and quality of life," offered in the Basic Plan as an aspect that Japan should be aiming for, the Ministry of Education, Culture, Sports, Science and Technology in April 2003 established the "Study Group on Science and Technology Policy for Building a Safe and Secure Society," consisting of representatives from industry, academia, and government, to conduct studies into scientific and technological policies toward the realization of a society that can ensure safety and security. An interim report was prepared in September 2003, and the final report was completed at the end of April 2004. In addition, the "Japan-U.S. Workshop on Science and Technology for a Secure and Safe Society" was convened in February 2004 to discuss how Japan and the United States can cooperate in the fields of science and technology in response to the various risks and threats that confront society, and is continuing a wide range of studies toward building a safe and secure society.

In June 2003, the Committee on Cultural Resources was established under the Subdivision on Resources of the Council for Science and Technology to look at cultural resources from the perspective of science and technology, and to engage in surveys and discussions regarding the promotion of science and technology that support the preservation, application and creation of cultural resources. A report, "Promotion of Science and Technology Supporting the Preservation, Application and Creation of Cultural Resources," was issued by the division in February 2004.

## 3.3 Reform of Japan's Science and Technology System

### 3.3.1 Reform of Japan's Research and Development System

#### 3.3.1.1 Building Research and Development Systems to Produce Excellent Results

##### 3.3.1.1.1 Developing a Competitive Research and Development Environment

The Science and Technology Basic Plan sets forth the reform of Japan's science and technology system as a critical policy for creating and utilizing excellent output. To form a competitive research and development environment, the Basic Plan sets a goal of doubling the use of competitive funding during the period that the Basic Plan is in force. In order to maximize its effectiveness, the Basic Plan also calls for system reforms, including the implementation of appropriate evaluation measures and the expansion of indirect expenses. The competitive funding for each ministry is shown in Table 3-3-1.

## Table 3-3-1 Comprehensive list of competitive funding

| Name of ministry/agency | Sponsoring institution | Name of program | FY2002 | | FY2003 | |
|---|---|---|---|---|---|---|
| | | | Budget (million yen) | Indirect expenses introduced (million yen) | Budget (million yen) | Indirect expenses introduced (million yen) |
| Ministry of Internal Affairs and Communications | Ministry | Promotion Programme Strategic Information and Communications R&D | 1,350 | 258 | 2,250 | 479 |
| | Telecommunications Advancement Organization of Japan | Program for Promotion of Basic Research in the Information and Communications Sectors | 1,120 | 145 | 630 | 91 |
| | Telecommunications Advancement Organization of Japan | R&D Program for Utilization of Gigabit Network | 200 | 26 | 112 | 11 |
| | Telecommunications Advancement Organization of Japan | Advanced technology development for pioneering new communications and broadcasting areas (Telecom incubation) | 425 | None | 475 | None |
| | Telecommunications Advancement Organization of Japan | Program for Promotion of Private-Sector Basic Technology Research | 10,700 | 2,199 | 10,500 | 2,245 |
| | Fire and Diaster Management Agency | Program for Promotion of Science and Technology Research for Fire Safety and Disaster Prevention | – | – | 199 | 28 |
| **Subtotal** | | | **13,795** | **2,628** | **14,166** | **2,855** |
| Ministry of Education, Culture, Sports, Science, and Technology | Japan Society for the Promotion of Science | Grants-in-Aid for Academic Research | 170,300 | 11,560 | 176,500 | 12,531 |
| | Japan Science and Technology Agency | Basic Research Programs | 42,689 | 1,083 | 44,689 | 2,848 |
| | Ministry | Special Coordination Funds for Promoting Science and Technology (Chosei-hi) | 36,500 | 2,254 | 37,700 | 3,254 |
| | Ministry | Public Proposal System for Ingenious Technology Development Research | 5,277 | 283 | 3,562 | 248 |
| | Ministry | Support System for Creation of University-Derived Venture Companies | 1,823 | 401 | 1,786 | 369 |
| | Japan Science and Technology Agency | Support System for Creation of University-Derived Venture Companies (In FY2003: Project to Create University-based Start-ups) | – | – | 502 | 104 |
| | Ministry | Grants for future pioneering science research | 9,000 | None | 6,646 | None |
| **Subtotal** | | | **265,589** | **15,581** | **271,386** | **19,354** |
| Ministry of Health, Labour, and Welfare | Ministry | Health and Labour Sciences Research Grants | 39,284 | 796 | 38,011 | 1,561 |
| | Pharmaceuticals and Medical Devices Agency | Program for Promotion of Basic Research in the Health Care Sector | 7,062 | None | 6,562 | Not yet determined |
| **Subtotal** | | | **46,346** | **796** | **44,573** | **1,561** |
| Ministry of Agriculture, Forestry, and Fisheries | Bio-oriented Technology Research Advancement Institution | Program for promotion of basic research for creation of new technologies and new sectors | 4,010 | 274 | 3,983 | 401 |
| | | R&D program for creation of new enterprises | 1,591 | None | 1,213 | None |
| | | Program for the Promotion of Research on the Integration of Different Fields for the Creation of Bio-oriented Industries | – | – | 339 | 3 |
| | Ministry | Technology Development Project for the Creation of Collective Private Agribusiness | 560 | None | 560 | None |
| | Ministry | Research project for utilizing advanced technologies in agriculture, forestry and fisheries | 1,808 | 403 | 1,973 | 441 |
| **Subtotal** | | | **7,970** | **678** | **8,067** | **845** |
| Ministry of Economy, Trade, and Industry | New Energy and Industrial Technology Development Organization | New Energy and Industrial Technology Development Organization | 5,280 | 1,027 | 5,280 | 1,062 |
| **Subtotal** | | | **5,280** | **1,027** | **5,280** | **1,062** |
| Ministry of Land, Infrastructure, and Transport | Japan Railway Construction, Transport and Technology Agency | Program for Promoting Fundamental Transport Technology Research | 392 | 22 | 389 | 35 |
| | Ministry | R&D fund support program for the development of construction technology | 240 | 51 | 250 | 53 |
| **Subtotal** | | | **632** | **73** | **639** | **88** |
| Ministry of the Environment | Ministry | Global Environmental Research Fund | 2,895 | 174 | 2,965 | 249 |
| | Ministry | Environmental Research and Technology Development Fund | 765 | 111 | 765 | 117 |
| | Ministry | Ministry of the Environment Waste Management Research Grants | 1,050 | 57 | 1,150 | 54 |
| **Subtotal** | | | **4,710** | **342** | **4,880** | **420** |
| **Total** | | | **344,322** | **21,126** | **348,991** | **26,185** |

Notes: 1. The initial budget amount, which served as the basis for doubling competitive funding during the period of the Second Science and Technology Basic Plan.

2. Figures in each column and in the totals columns are rounded up to the nearest whole number, and may not add up.

3. The "indirect expenses introduced" figures are estimated as of FY2001.

4. Programs besides those given above are under review for potential registration as competitive funding.

Based on the "Reform of the Competitive Funding System (opinion)" prepared by the Council on Science and Technology Policy on April 21, 2003, progress was made on the following reforms during FY2003: (1) further expansion of indirect expenses; (2) posting of program officers with research backgrounds to each funding agency to improve the implementation structure that will be responsible for consistently servicing the array of business of the competitive funding system from the science and technology side; (3) entrusting the funds distribution function to independent funding agencies; and (4) pushing forward the delivery period of research funds.

### 3.3.1.1.1.1 Competitive Funding of Ministries

#### (1) Ministry of Internal Affairs and Communications

The Ministry of Internal Affairs and Communications is implementing the "Strategic Information and Communications R&D Promotion Programme." This project aims to actively promote unique and innovative research and development that is in keeping with priority strategic targets in order to create world-leading intellectual assets, increase the level of researchers by creating competitive research environments, and improve research and development capabilities in information and communications technologies.

#### (2) Ministry of Education Culture, Sports, Science and Technology

The Ministry of Education, Culture, Sports, Science and Technology oversees roughly eighty percent of the total budget for Japan's competitive funding, and administers the following distinctive systems.

The Grant-in-Aid for Scientific Research Program aims to dramatically advance academic research (research based on the free-thinking of researchers) across all fields from the humanities and social sciences to the natural sciences, and from basic to applied. The program supports creative and pioneering research that has gone through a peer review process. About 85,000 new applications were received in FY2004, and about 21,000 of them were awarded.

Basic Research Programs promote basic research that contributes to the creation of advanced technologies, for which the Japan Science and Technology Agency (JST) establishes research areas based on strategic sectors designated by the Ministry of Education, Culture, Sports, Science and Technology on the basis of projected future social demands. Research themes for each area are publicly sought from all sorts of government, academic, and industry research institutions, such as national experimental research institutions and universities. In FY2003, the following were established as two new strategic sectors: (1) Development of a Technological Infrastructure for the Realization of Quantum Information Processing that Introduces Innovations into Information Communications Technology; and (2) Elucidation of a Human Life-long Learning Mechanism Based on the Knowledge of Brain Science with an Intention to Provide a Solution to the Problems in Education.

The Special Coordination Funds for Promoting Science and Technology (Chosei-hi) take the initiative in the coordination and promotion of projects important for science and technology policy, along with policies laid down by the Council for Science and Technology Policy. Since FY2003, the new "Basic Survey and Research on Promotion of Science and Technology" program has been established in order to encourage examination on the future policy for promoting science and technology following the current Science and Technology Basic Plan.

The "Open Competition for the Development of Innovative Technology" invites the public to submit proposals for innovative and highly creative seeds of technology, and subsidizes the de-

velopment of those technologies utilizing the potential of universities in order to foster the proposals into even more innovative and practicable forms.

The "Project for Creation of University-based Start-ups" aims to promote the return of the fruits of university research to society and the economy through the creation of university-based start-ups. The JST promotes the R&D needed to realize business start-ups based on the results of university research.

The Subsidies for Research for the Future Program implemented by the Japan Society for the Promotion of Science promotes university-led academic research with the potential to produce intellectual assets leading to the future development of Japan.

## (3) Ministry of Health, Labour and Welfare

The Ministry of Health, Labour and Welfare strives to improve technology standards through the scientific promotion of government measures related to health and medical care, welfare, environmental health, occupational safety and health, and other aspects relevant to the citizens of Japan.

The Grant for Health Sciences promotes research in four main areas, including (1) the administrative policy research area; (2) the comprehensive project research area, which includes "Comprehensive Research for Cancer Control" based on the Second 10-Year Cancer Strategy, and "Research on Human Genome Tissue Engineering;" (3) the advanced health sciences area, which includes "Research on Advanced Medical Technology," which strives to promote research on nanotechnology, and "Research on Emerging and Re-emerging Infectious Diseases"; and (4) comprehensive research on safety management in the drug, food and technology area, which includes "Research on Health Sciences Focusing on Drug Innovation."

## (4) Ministry of Agriculture, Forestry and Fisheries

In FY2003, the Ministry of Agriculture, Forestry and Fisheries established the "Program for the Promotion of Research on the Integration of Different Fields for the Creation of Bio-oriented Industries," which aims to create new industries and enterprises through biotechnology and other bio-oriented advanced technologies. Existing programs include the "research project for utilizing advanced technologies in agriculture, forestry and fisheries," which aims to promote in-the-field experiments and research in the agriculture, forestry, and fisheries sector, and the "Technology Development Project for the Creation of Collective Private Agribusiness," which aims to revitalize agribusiness through the creation of new industries. Furthermore, measures for joint research aimed at strengthening basic research that promotes the advanced use of biological functions are implemented by the National Agriculture and Bio-oriented Research Organization.

## (5) Ministry of Economy, Trade and Industry

The Ministry of Economy, Trade and Industry subsidizes the New Energy and Industrial Technology Development Organization (NEDO), and implements the "Industrial Technology Research Grant Program" in an effort to develop human resources for industrial technology research and discover potential seeds of new industrial technologies that meet the needs of the industrial world and society by providing research funds to assist young researchers.

## (6) Ministry of Land, Infrastructure and Transport

Through the Japan Railway Construction, Transport and Technology Agency, the Ministry of Land, Infrastructure and Transport implements the "Program for Promoting Fundamental Transport Technology Research." This program promotes creative and innovative basic research aimed at generating innovative new technologies

with the potential for breakthrough technological innovation. In addition, the Construction Technology Research and Development Subsidy Program provides research and development subsidies to researchers at universities, etc., in order to promote cooperation with non-construction sectors, to promote innovations in construction technology in broad interdisciplinary areas, and to utilize the innovative results in public works projects.

## (7) Ministry of the Environment

The Ministry of the Environment utilizes the Global Environment Research Fund to promote research into global environmental conservation, based on the Comprehensive Promotion Program for Global Environment Research, Monitoring and Technology that is drawn up at the Council of Ministers for Global Environmental Conservation.

The Global Environment Research Fund provides prioritized and strategic promotion for the development and diffusion of environmental technologies, while the Fund for Waste Disposal Science Research is used to promote restrictions on waste disposal and to encourage recovery and reuse, and develops research on all kinds of research into appropriate waste disposal measures.

### 3.3.1.1.2 Improving the Mobility of Pesonnel through Popularization of the Fixed-term System

In order to train researchers with broad perspectives who are rich in creativity and originality, and to be competitive and dynamic R&D environments, it's important that the mobility of researchers is improved and that researchers have experience at many kinds of research sites.

With an aim toward such improved mobility of researchers, employment of fixed-term researchers became possible at national experimental research institutions in accordance with "the Law Concerning the Special Measure for the Recruitment, Remuneration and Working Hours of Researchers with Fixed Terms in the Regular Service" enacted in 1997. The performance to date is shown in Table 3-3-2.

**Table 3-3-2 State of employment under the "Law Concerning the Special Measure for the Recruitment, Remuneration and Working Hours of Researchers with Fixed Terms in the Regular Service"**

| | No. of institutions | No. of personnel used |
|---|---|---|
| National research institutes | 36 | 785 |
| Of which, by invitational type | 17 | 124 |
| Of which, researcher-fostering type | 35 | 661 |

Note: The number of personnel used indicates the cumulative number as of October 1, 2003.

Source: Survey by National Personnel Authority (October 2003)

For universities and inter-university research institutes, "the Law Concerning the Fixed-Term Appointment of Faculty Members at Universities," enacted in 1997, gives them the discretion to adopt the fixed-term system. The status of the fixed term system adopted on the basis of this law is shown in Table 3-3-3.

**Table 3-3-3 State of the fixed-term systems introduced under the "Law concerning the Term of Office for Faculty"**

| | No. of universities, etc. | No. of instructors used |
|---|---|---|
| National universities | 65 | 3,546 |
| Public universities | 12 | 131 |
| Private | 119 | 1,571 |
| Inter-university research institutions | 9 | 73 |

Source: Survey by MEXT (October 2002)

The Basic Plan calls on the nation's research institutions "to prepare plans showing suitable policies for hiring re-searchers based on a fixed-term and public canvassing basis." The Ministry of Education, Culture, Sports, Science and Technology informed all relevant institutions in February 2002 of the "Basic Guidelines for Improvement of Researcher Mobility," decided upon by the Council for Science and Technology Policy in December 2001. The nation's research institutions are expected to actively try to improve researcher mobility by introducing a fixed-term system and implementing public canvassing.

## 3.3.1.1.3 Increasing the Independence of Young Researchers

If Japan is to aim toward becoming an advanced science- and technology- oriented nation, it is critical to foster and secure exceptional young researchers with abundant creativity who will lead future research activities.

The Basic Plan calls for "ensuring the independence of young researchers in order to maximize the abilities demonstrated by distinguished young researchers."

### 3.3.1.1.3.1 Support for Creative Research Activities by Young Rsearchers

Many of the researchers around the world who come up with world-class research results have already conducted research in their 30s that lays the groundwork for later achievements. The relevant government ministries, therefore, promote various efforts to support creative research activities by young researchers during their foundational years.

#### (1) Ministry of Internal Affairs and Communications

Under the "Program for Promoting Strategic Information and Communications Research and Development," established in FY2002, the "research and development program for nurturing young advanced-IT researchers" was instituted with the aim of nurturing young researchers who are age 35 or younger.

#### (2) Ministry of Education, Culture, Sports, Science and Technology

MEXT is working to expand competitive funding for young researchers by appropriating approximately 20.9 billion yen of the Grants-in-Aid for Scientific Research for young researchers in order to create a system in which young researchers who have flexible mind-sets and a spirit of challenge can conduct independent research.

### (3)Ministry of Agriculture, Forestry and Fisheries

The National Agriculture and Bio-oriented Research Organization (NARO) is working through the Basic Research Promotion Project, which aims at the creation of new technologies and new sectors, to institute a young researcher support program that prepares the conditions for objective research by young researchers with flexible thinking and ambition.

### (4) Ministry of Economy, Trade and Industry

In FY2000, NEDO started the "Industrial Technology Research Grant Program" for promoting basic and creative research and development by providing research fund to assist young researchers.

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## 3.3.1.1.3.2 Support for Postdotoral Researchers

Concerning postdoctoral researchers who conduct supervised research, the Basic Plan states that "In the future, the post-doctoral program should be qualita of postdoctoral researchers by having them participate in research projects funded with the expanded competitive funding, as well as promote various other systems to support postdoctoral researchers.

### (1) Ministry of Education, Culture, Sports, Science and Technology

Through the Japan Society for the Promotion of Science, MEXT has been promoting since 1985 the "Research Fellowships for Young Scientists" program that supports postdoctoral researchers who possess superior research abilities so that they can proactively engage in their research. Since FY2003, by focusing support as a general rule on postdoctoral researchers who are active at locations other than their alma mater research departments, this program strives to achieve qualitative results, such as cultivating creativity and broad views through the selection of diverse research environments.

Various other support programs for researchers are also being promoted, such as the Institute of Physical and Chemical Research (RIKEN) "Special Postdoctoral Researchers Program," which provides a place where highly creative young researchers can proactively conduct research upon their own initiative at RIKEN's research facilities.

### (2) Ministry of Health, Labour and Welfare

The Ministry of Health, Labour and Welfare has adopted measures to support and utilize 541 post-doctorals through its Health and Welfare Sciences Research Promotion Project.

### (3) Ministry of Agriculture, Forestry and Fisheries

The Ministry of Agriculture, Forestry and Fisheries has adopted measures to utilize 147 young researchers as part of the Basic Research Promotion Project of the National Agriculture and Bio-oriented Research Organization (NARO), which is aimed at creating new technologies and research fields. In total, the Ministry adopted measures to utilize 176 postdoctoral researchers.

### (4) Ministry of Economy, Trade and Industry

The Ministry of Economy, Trade and Industry provided support and adopted measures to utilize a total of 170 postdoctoral researchers through the industrial technology fellowship program run by the New Energy and Industrial Technology Development Organization (NEDO).

## 3.3.1.1.4 Reform of Japan's Evaluation Systems

To promote science and technology, it is important to conduct appropriate evaluations, which stimulate researchers and encourage outstanding research and development activities. Effective evaluations will increase the efficiency and vital-

ity of R&D activities, facilitate better R&D achievements, and nourish superior researchers. Evaluations also offer benefits to society and the economy, and also serve for accountability to the public.

The Basic Plan sets forth reforms of the evaluation system as one of its pillars for developing a science and technology system that will deliver excellent results. Based on the Second Basic Plan, the "National Guidelines on the Method of Evaluation for Governmental R&D" were decided upon by the Prime Minister in November 2001 to improve the evaluation program further. All ministries and agencies implement effective evaluations with detailed guidelines specifying evaluation methodologies under the revised General Guidelines.

In addition, the Cabinet Office, in cooperation with related ministries and agencies, developed a government R&D database system that brought together in a single, cross-ministerial system data on researchers, funds, accomplishments, evaluators, and evaluation results for government-funded individual research and development topics. Along with storing data, the system is being used for data analysis by the Cabinet Office and related ministries and agencies.

For other actions in this area, evaluations of the performance of incorporated administrative R&D agencies are now being implemented based on the Law on the General Rules of Incorporated Administrative Agencies (1999 Law No.103). In addition, under the Law for Evaluations of Policies Performed by Administrative Institutions (2001 Law No.86), which took effect in April 2002, it has been made mandatory to conduct appraisal evaluations for research and development topics that are expected to incur large costs, given their preceding experience in project evaluation.

### 3.3.1.1.5 Flexible, Effective, and Efficient Program Management

Flexible, effective, and efficient program operations and the efficient use of funding are necessary in accordance with the characteristics of research and development. For this reason, at the national experimental research institutions, efforts are being made to fully utilize organizational structures that allow mobile and flexible changes based on internal measures. These changes are aimed at responding to progress and changes in research and development, including the priority allocation of funding at the discretion of institute directors, etc., in response to research performance, and the placement of researchers and establishment of research periods in line with research topics.

The Ministry of Education, Culture, Sports, Science, and Technology uses the Special Coordination Funds for Promoting Science and Technology (Chosei-hi) to position "Urgent Research and Development" within the "Promotion of Advanced Research," in order to ensure a timely response to situations requiring urgent measures to be taken during the fiscal year. Emergency investigation and research activities during FY2002 are as shown in Table 3-3-4.

**Table 3-3-4 Promotion of advanced research (urgent research subjects)**

| Year implemented | Name of core institution | Name of investigation and research subject |
|---|---|---|
| 2003 | National Institute of Infectious Diseases | Emergency research on diagnostic and testing methods for Severe Acute Respiratory Syndrome (SARS) |
| | Earthquake Research Institute, University of Tokyo | Emergency research on the 2003 Tokachi-oki Earthquake |
| | National Institute of Animal Health, National Agriculture and Bio-oriented Research Organization | Emergency Research on Measures to deal with Highly Pathogenic Avian Influenza (Note) |

Note: Specified as added research in FY2003

Furthermore, to address situations in which teachers at national universities, etc., are engaged in re-search commissioned from corporations or other outside bodies, the Ministry of Education, Culture, Sports, Science and Technology moved in FY1998 to merge the three expense categories into a single new accounting item (research expenses for partnerships between universities and industry, etc.) in order to encourage a flexible response to changes in expense items that occur as research progresses or as research plans change.

As regards research presentations at study meetings, Section 30 of the Japanese Patent Law stipulates that "the fact that the person having the right to obtain a patent" "has made a presentation in writing at a study meeting held by a scientific body designated by the Commissioner of the Patent Office" shall be deemed as an exception to lack of novelty of invention. The Japan Patent Office (JPO) has been making this provision applicable to research activities at universities.

### 3.3.1.1.6 Utilizing Personnel and Developing Diversified Caree Paths

To reinvigorate research activities, universities and research institutions are expected to make active efforts to ensure the involvement of diversified personnel.

"On Policy for Promoting the Internationalization of Scientific and Technological Activities," a report released on January 2003 by the Internationalization Promotion Committee of the Science and Technology Council, raises the promotion of international exchange among researchers as a policy that should be given priority encouragement. The report also speaks to the need to invite distinguished foreign researchers to Japan, and to promote young researchers to take long overseas research sojourns.

Furthermore, in its second recommendation, "Aiming to foster and secure research personnel in order to increase global competitiveness," released in June 2003, the Council for Science and Technology's Committee on Human Resources made suggestions for moving toward the realization of environments in which diverse personnel can demonstrate their full abilities and concentrate on their research. These suggestions included the fostering of creative and competitive environments that encourage diversity, and the promotion of participation by female researchers and encouraging them to demonstrate their abilities.

Based on these reports and recommendations, the Japan Society for the Promotion of Science is enhancing its researcher exchange programs, includ-

ing its overseas research fellowships and postdoctoral fellowships for foreign researchers. Since FY2003, the Grants-in-Aid for Scientific Research Program has been flexibly managed to support female researchers by allowing them to resume research funded by the program after one-year maternity leave interruptions. In like manner, the Japan Society for the Promotion of Science in July 2003 began permitting interruptions and extensions of fellowships at the request of young researchers for the purpose of childbirth and child-rearing.

Various career paths must be opened up so that researchers can become involved, as their aptitude permits, in a wide spectrum of R&D-related work, including the planning and management of research and development, and other management tasks.

In light of these needs, the Japan Society for the Promotion of Science and the JST established in FY2003 the program manager position for people with research experience who will hold responsibility for part of he business chain of the competitive funding system.

### 3.3.1.1.7 Achieving a Creative Research and Development System

To create excellent research results and to realize a research and development system capable of pioneering a new era, the heads of research institutions of a certain size need to use superior concepts and leadership to promote organizational reform at their R&D institutions, and to create Centers of Excellence (COEs) with international appeal.

Toward this end, the Special Coordination Funds for Promoting Science and Technology (Chosei-hi) have been used since FY2001 for supporting the start of the “Strategic Fostering Research Centers of Excellence” program. The program fosters and supports R&D institutions that make creative and pioneering attempts to build novel R&D systems and reform organizations operations and whose highly successful efforts influence other R&D institutions.

In FY2003, two institutions were selected for fostering under the program, as shown in Table 3-3-5.

**Table 3-3-5 Fostering strategic research centers (Targeted institutions)**

| | Name of targeted institution | Concept |
|---|---|---|
| 2001 | Research Center for Advanced Science and Technology, The | Open laboratory for human- and society-focused advanced science and technology |
| | Graduate School of Engineering, Osaka University | Plan for Frontier Research Center |
| 2002 | Graduate School of Medicine, Kyoto University | Formation of an open medical research center of excellence through harmonization of advanced fields |
| | Incorporated Administrative Agency: National Institute of Advanced Industrial Science and Technology | Innovation Center for Start-ups |
| 2003 | Graduate School of Medicine, Tohoku University | Formation of an advanced biomedical engineering center of excellence |
| | "Sousei" Creative Research Initiative, Hokkaido University | Plan for a Hokaido University research and business park |
| | National Institute for Material Science | Specified District Young and International Innovation |

## 3.3.1.2 Promotion and Reform of R&D at Japan's Main Research Institutes

### 3.3.1.2.1 Universities and InterUnvesity Research Institutes

As one of their directives, Japan's universities and inter-university research institutes are entrusted with the task of securing the academic foundation and improving the academic standards of Japan, with a focus on academic research. The essence of university-level academic research is to give rise to new and richly creative knowledge based on liberal and open ideas, and the independent research activity of researchers. Furthermore, university-level academic research shall be characterized by the goal of advancement in study carried out over a broad range of fields in the areas of humanities, social sciences, and natural sciences, shall possess a respect for the independent nature of researchers as being essential to such progress, and shall function for the integrated promotion of research and education.

Based on reports and suggestions forwarded by the Science Council, the Ministry of Education, Culture, Sports, Science and Technology strives to provide for Japan's foundation for academic research in a planned and prioritized manner, and to proactively implement a comprehensive policy for the nation by increasing research funding, improving research facilities and equipment at universities and inter-university research institutes, nurturing and recruiting exceptional researchers, prioritizing the promotion of basic research, forming COEs, improving the evaluation of research, and developing and expanding upon the science information infrastructure, in order to develop an academic research system that is open to the world, and which is capable of flexibly responding to advancements in scientific research.

Expanding the independence of management at national universities and inter-university research institutes in the areas of budget, organization, and personnel affairs, the National University Corporation Law came into effect in July 2003 with the aim of developing appealing national universities and inter-university research institutes with distinctive identities that actively address education, research, and contributions to society, and establishing management structures that are open to public scrutiny. In April 2004, national universities and inter-university research institutes will be incorporated.

Furthermore, efforts are being made, primarily by the Cabinet Office, to establish universities in Onna-son, Okinawa, with graduate school curricula in science and technology of the highest international standards, that embrace the new

mindset of “internationalism” and “flexibility” as basic concepts, with the aim of getting Okinawa to take part in Japan’s and the world’s scientific and technological advances, and to develop Okinawa into a region of advanced, concentrated brain power within the Asia-Pacific region.

### 3.3.1.2.1.1 Academic Research at Universities and Inter-University Research Institutes

Researchers at universities nationwide are making use of research at their universities, departments, graduate schools, research laboratories, and research facilities, as well as joint-use inter-university research institutes, without being tied to a specific university.

In an age of advancements in academic research that are characterized in particular by the increasing large scale and sophistication of research techniques, researchers in many research fields are finding it increasingly necessary and efficient to carry out joint research. For this purpose, priority is being placed on the development of joint use infrastructures such as inter-university research institutes, as well as research laboratories and research facilities within universities, in order to expand the infrastructure of research organizations. In addition, efforts are being made to reinvigorate research institutes and give them greater flexibility to respond to the growth of interdisciplinary fields and the existence of social demands, etc., that have accompanied advancements in academic research.

The inter-university research institutes make significant contributions to research advancements in a variety of fields by acting as centers for promoting joint research between researchers employed throughout the nation’s universities, and by providing a place for the joint use of facilities, equipment, and materials that are unique or large in scale. Projects such as the B-Factory project of the High Energy Accelerator Research Organization (KEK) and SUBARU, optical-infrared telescope, project of the National Astronomical Observatory of Japan (NAOJ) also promote cutting-edge international research. As part of the university education system, the inter-university research institutions carry out research and education in an integrated manner that is typified by the acceptance of graduate students. By the end of FY2003, a total of 13 inter-university research institutions and 16 research laboratories had been established.

Research laboratories devoted to research in designated specialized fields have also been established at universities. These research laboratories carry out specialized research in collaboration with education and research carried out at university departments and graduate schools. At the end of FY2003, a total of 58 research laboratories had been established at the national universities, including 19 research institutions for joint use for the nation’s universities. Research projects such as the neutrino research conducted by the Institute for Cosmic Ray Research (ICRR) of the University of Tokyo have produced research results of the highest international standards.

To secure research funds to promote research conducted at universities, efforts have been made to secure two types of funding, ordinary “fundamental” funds to support basic research activity, and “competitive” funds that are selectively allocated to exceptional research in accordance with appropriate reviews and evaluation of research.

Of these funds, ordinary research expenditures are specifically intended to support research based on researchers’ liberal and open ideas. At national universities, such expenses are incurred as educational research foundation schooling expenditures and travel expenditures for faculty research. At private universities, subsidies are provided for operating costs related to ordinary research expenditures and research projects that respond to strong social demand. In terms of competitive funding, Grants-in-Aid for Scientific Research are being increased with the aim of achieving significant advancements in exceptional research being carried out in a broad range of fields, and capital investments in the Japan Society for the Promotion of Science (JSPS) are

being utilized to implement the Research for the Future (RTTF) program, which prioritizes the promotion of visionary and richly creative research with the potential to produce intellectual assets.

### 3.3.1.2.1.2 Expanding Support for Japan's Private Universities

Roughly 75 percent of Japan's university students attend private universities, which actively carry out characteristic educational research activity based on the unique spirit upon which each university was created. Accordingly, the Ministry of Education, Culture, Sports, Science and Technology implements the following measures in order to support private universities.

To support operating costs, the Ministry established in FY2002 the "Special Expenses for Advancing Higher Education and Research Levels at Private Universities," with the aim of creating world-class universities. This aid provides prioritized assistance according to the state of each university's efforts in education and research.

To assist in the development of facilities and equipment, the Ministry appropriates funds needed to support the remodeling of facilities to make them multimedia-capable, the installation of on-campus LAN systems, and the provision of the research facilities and equipment needed to implement the "Program for Promoting Advancement of Academic Research at Private Universities," which offers comprehensive support, including facilities and equipment, to excellent research projects.

Furthermore, since April 1, 2002, certain projects related to research commissioned by third parties and undertaken at private universities have been exempted from applicable corporate taxes for profit-earning projects. In addition, in April 2003, the procedure to obtain the approval of the Commissioner of the National Tax Agency for exempting "deemed transfer income" private contributions of property from applicable income taxes was simplified for those who fulfill certain requirements in the case of contributions to educational corporations that found private universities.

### 3.3.1.2.1.3 Deliberations in the Council for Science and Technology

The Council for Science and Technology conducts research and deliberations in response to inquiries posed by the Ministry of Education, Culture, Sports, Science and Technology regarding matters important to the comprehensive promotion of science and technology, and to the promotion of learning in general; it also provides opinions to the minister. The Subdivision on Science was established within the Council in order to conduct research and deliberations on matters important to the promotion of learning that takes place primarily at universities. In FY2003, the Subdivision on Science put together a report in April on "Making Joint-Use University Facilities into Corporate Bodies," and one on "The State of Attached Laboratories and Research Institutions under the New National University Corporation System." In October 2003, the Subdivision put together a report on "The State of Big Science."

### 3.3.1.2.1.4 Activities of the Science Council of Japan (SCJ)

The Science Council of Japan (SCJ) was originally founded in 1949, and is the leading organization representing Japan's scientists, both domestically and internationally.

The SCJ's 19th term began in July 2003. Building on the remarkable achievements of the 18th term, beginning with those of the Committee on Japan Perspective and the Committee on New Science Scheme, SCJ drew up action plans for the 19th term, including the setup of eight special committees to functionally respond to short- and long-term assignments that require examination. These committees are proceeding with their examinations, emphasizing comprehensive points of view that cut across departmental disciplines, such as the integration of the humanities and science, and taking care-

ful note of new viewpoints being demanded in today's academic world, such as consideration of perspectives on gender.

The Bill to Amend Part of the Science Council of Japan Law was proposed in February 2004 in the 159th session of the Diet. The Bill was designed to revise the Science Council of Japan's jurisdiction, organization, method of recommending members, and other related matters based on the conclusions concerning the status of the Science Council of Japan that were reached through the deliberations of the Council for Science and Technology Policy, made based on the provisions of Article 17, Paragraph 9 of the Basic Law for Central Government Reform. The Bill was passed and promulgated in April 2004.

## (1) Deliberation Activities

Recognizing that Antarctic region observation is an important national project that should be continuously addressed by the whole government, the SCJ submitted to the government in September 2003 a demand for the "Continuation and Enhancement of the Antarctic Region Observation Project." It pointed out that necessary actions must be taken to realize the continuation and enhancement of the project, beginning with the preparation of transport methods such as research ships.

In order to provide a report in reply to the Ministry of Agriculture, Forestry and Fisheries' October 2003 inquiry on the "Content and Assessment of the Multiple Functions of Fisheries and Fishing Communities with Respect to the Global Environment and Human Life," the SCJ set up the Special Committee on the Multiple Functions of Fisheries and Fishing Communities. The committee is currently considering the issue from a wide-ranging perspective that integrates the humanities, social sciences, and natural sciences.

## (2) International Scientific Echange

The SCJ represents Japan through its affiliation with many international scientific organizations, including the International Council for Science (ICSU). The SCJ actively works with international programs for scientific cooperation, and strives for coordination with other countries

The Asian Conference on Scientific Cooperation (ACSC) gathered scientists from ten Asian countries to a conference held in Tokyo on an annual basis until FY2000 for the purpose of collaboration and cooperation among Asian countries in scientific research. It was reorganized into an international scientific organization, the Science Council of Asia (SCA), for which the SCJ serves as secretariat, and member countries host its conference in rotation. Conferences are convened annually on the theme of sustainable development in Asia. The third conference was held in Indonesia in May 2003.

In December 2003, SCJ hosted the "International Conference on Science and Technology for Sustainability – Energy and Sustainability Science" in Tokyo. Discussions were held at the conference between relevant Japanese and foreign scientists on the roles that the scientific community should play within the international community in order to build energy sustainability, and specific recommendations were gathered.

The Science Council of Japan also obtains approval from the Cabinet to host important international conferences related to science. These conferences are held in Japan and jointly hosted with relevant scientific research organizations. In FY2003, the Council co-hosted eight such conferences, including the International Union of Geophysics and Geodesy 2003 General Assembly.

## (3) Open Lectures and Symposiums

The SCJ sponsors open lectures as a way of giving science results back to the citizens of Japan. The SCJ also actively sponsors symposiums that engage in various scientific issues. The Divisions and Liaison Committees of the SCJ play a

central role in organizing such symposiums in cooperation with various academic institutions.

In FY2003, the SCJ hosted two open lectures and 98 symposiums.

Furthermore, the SCJ jointly hosted with the Cabinet Office and Nippon Keidanren (Japan Business Federation) the "Second Conference on the Promotion of Industry-Academia-Government Collaboration" in Kyoto in June 2003, and the "Third Summit on Industry-Academia-Government Collaboration" in Tokyo in November 2003, in order to promote collaboration between industry, academia, and government. The SCJ also hosted a "Regional Promotion Forum" in Nagoya in November 2003, in Sapporo in December 2003, and in Hiroshima in January 2004.

### 3.3.1.2.2 National Experimental Research Institutions, Public Experimental Research Institutions, and Incorporated Administrative Agencies

National experimental research institutions, incorporated administrative agencies, and public experimental research institutions are assigned the task of achieving policy targets. It is critical for these organizations to carry out prioritized research and development that centers on basic, pace-setting research to improve the nation's science and technology level. They should also carry out systematic and integrated research that sets concrete targets in line with policy needs. Public experimental research institutions that belong to local governments shoulder the responsibility for carrying out technical development, and providing technical guidance that meets the needs of local industry and their region.

The total FY2003 expenditures related to science and technology, which cover experimental research, personnel, and facilities expenditures for the national experimental research institutions (including the Geographical Survey Institute, the National Geography Institute, the Japan Coast Guard's Hydrographic and Oceanographic Department, and other institutes), incorporated administrative agencies, and public research institutions, were 1.4366 trillion yen.

Moreover, based on the "Reorganization and Rationalization Plan of Public Corporations," public corporations that undertake research activities along with other public corporations will be converted into incorporated administrative agencies after October 2003, thereby putting into place a system in which they can implement more enhanced, effective, and efficient research activities.

### 3.3.1.2.3 Private Sector Research and Development

It is critical for the nation to reinvigorate the research and development activities of the private sector, which play an important role together with the activities of the national government. Therefore, it is important for the national government to increase the drive for a broad range of private sector research and development activities, based on the fundamental concept of self-reliance among the private sector.

### 3.3.1.2.3.1 Promoting Private Sector Research Activity through the Taxation System

Measures within the taxation system that aim to promote research and development by the private sector include systems that provides a tax credit on a certain percentage of gross experimental and research expenses, and a tax credit on a certain percentage of experimental and research expenses in joint academia-industry-government research collaborations and commissioned research.

Revisions to the taxation system in FY2004 extended until FY2005 special measures concerning the tax basis for fixed asset taxes on assets used for biotechnology research, following a reexamination of which equipment would be covered by the measures. Necessary measures were also taken to ensure that following their incorporation, national universi-

ties and inter-university research institutes would be covered by special measures concerning the real property acquisition tax and the fixed property tax for corporations subject to Article 34 of the Civil Law that develop facilities on the grounds of national universities for the purpose of joint research with those universities.

Table 3-3-6 shows the current tax measures through April 2004 that are related to the promotion of science and technology, including the measures introduced in this section.

## Table 3-3-6 Major preferential treatment for science and technology promotion

| Item | Purpose | Description | Applicable law | Date of enactment/ validity |
|---|---|---|---|---|
| R&D taxation system | Promotion of research and development investment by the private sector, etc. | I. Incremental Tax Credit for Increased Research Expenditures (Optional: Taxpayers may elect either I, II or III.)<br><br>(1) The research credit is 15% of the excess of research expenses over the base amount. (The base amount is the average of annual research expenses for the three years with the highest expenses in the five tax years preceding the current business year.) The maximum amount is the sum of 12% of the corporation tax liability (Corporate tax).<br><br>(2) Furthermore, when a corporation incurs special experimental and research expenses for joint research with national research institutes (including independent administrative institutions) and/or universities and colleges, a value equivalent to 15% of that value is added to the upper limit on the tax credit amount in (1) above (but the tax credit amount after the addition is limited to 14% of the equivalent of the corporate tax).<br><br>(3) Same for individual businesses (Income tax) | Special Taxation Measures Law, Article 10 (income tax), Article 42-4, Article 68-9 (corporate tax), Local Tax Law, Supplementary Provision, Article 8, Item 1. | Enacted in FY1967, effective through FY2005 |
| | | II. Proportional Tax Credits for total research expenses (Optional: Taxpayers may elect either I, II or III.)<br><br>a. Special Tax Credit for total research expenses<br>(1) The tax credit amount is a fixed percentage (10%-12% (FY2003-6) and 8-10% (after words)) of experimental and research expense totals (but limited to a value equivalent to 20% of corporate tax).<br>(2) Same for individual businesses (Income tax).<br><br>b. Special Tax Credit on joint and entrusted research based on industry-academic-government cooperation<br>(1) For joint experiments and research with, or experiments and research commissioned to, universities and public research institutes, consistent with item a. above, the tax credit amount is a value equivalent to 12% (increased by 3% to 15% as a special measure for FY2003-6) of these experimental and research expenses (but limited to a value equivalent to 20% of corporate tax with the special tax credit from item a. above added in).<br><br>(2) Same for individual businesses (Income tax). | | Enacted in FY2003 (The special measure period is effective until FY2005) |

| Item | Purpose | Description | Applicable law | Date of enactment/ validity |
|---|---|---|---|---|
| | | III. Tax system to strengthen the technical base of small and medium-sized corporations (Optional: Taxpayers may elect either I, II or III.)<br><br>(1) The tax credit amount is a value equivalent to 12% (increased to by 3% to 15% as a special measure for (FY2003-6) of test and research expenses at small and medium-size corporations (but limited to a value equivalent to 20% of corporate tax).<br><br>(2) Same for individual businesses (Income tax)<br><br>(3) The tax credit amount in (1) above is excluded from the tax base for corporate inhabitants tax (Local tax). | | Enacted in FY1985 (The special measure period is effective until FY2005.) |
| | | IV. Special Depreciation for Equipment used in Development Research<br><br>(1) When specified equipment for development research is acquired and used in domestic R&D, a special depreciation equivalent to 50% of the value at acquisition will be allowable (Corporate tax).<br><br>(2) Same for individual businesses (Income tax). | Special Taxation Measures Law, Article 11, Item 3 (income tax), Article 44-3, Article 68-20-2 (corporate tax) | Enacted in FY2003, effective through FY2005 |
| Deductions for Donations, etc | Promotion of science and technology | (1) The following donations made by individuals or corporations shall be given preferential treatment:<br>1. Donations to public interest corporations that are designated by the Finance Minister as being publicly solicited, contributing to the promotion of education or science, and assuredly going to urgent causes (Designated donations)<br>2. Donations to public interest corporations that promote education or science, significantly contribute to the public interest, and are donated to specified, qualified public-benefit promotion institution in relation to the main activities of the corporation;<br>3. Donations to specified approved charitable trusts that receive approval of the competent minister as promoting education or science, significantly contributing to the public interest, and filling specified requirements.<br>(2) With regard to donations of spot goods to corporations engaged in businesses in the public interest, and that receive approval of the Director-General of the National Tax Administration Agency as filling the requirements of promoting education or science. | (1) Corporate Tax Law, Article 37, Item 4; Income Tax Law, Article 78, Item 2<br><br>(2) Corporate Tax Law, Article 37, Item 4; Income Tax Law, Article 78, Item 2<br><br>(3) Corporate Tax Law, Article 37, Item 6; Income Tax Law, Article 78, Item 3<br>Special Taxation Measures Law, Article 40 | Enacted in FY1946 (corporate tax), Enacted FY1962 (income tax)<br>Enacted FY1961 (corporate tax), Enacted FY1962 (income tax)<br>Enacted in FY1987<br>Approval procedure streamlined in FY2003 |
| Measures for Tax Exemptions on Research Assets of Scientific Research Corporations | Promotion of science and technology | Assets provided to corporations established under Civil Law Article 34 for the purpose of scientific research are exempted from the real property acquisition tax, fixed property tax, special land holding tax, and city planning tax, subject to their direct use in that | Local Tax Law, Article 73-4, Item 1, Article 348, Item 2, Article 586, Item 2, Article 702-2, Item 2 | Fixed property tax in 1951, real property acquisition tax in 1954, city planning tax in FY1956, special land holding |

| | | | | |
|---|---|---|---|---|
| | | research. | | tax in FY1973 |
| Special Measures for Property Taxation Standards related to Biotechnology Research Assets | Reduction of burdens related to prevention of danger and harm to the public | Of the equipment that is required for experiments and research in gene recombination technologies, etc., the tax base for the purpose of fixed property tax is reduced to three-fourths for three fiscal years for new equipment that is acquired for the purpose of taking nonproliferation measures in accordance with the "Law Concerning the Conservation and Sustainable Use of Biological Diversity through Regulations on the Use of Living Modified Organisms." | Local Tax Law Supplementary Provisions, Article 15, Item 22 | Enacted in FY1986, effective through FY2003 |
| Tax system for Promotion of Research Exchanges | Promotion of research exchanges, and revitalization of local economies | When corporations subject to Article 34 of the Civil Law develop facilities on the grounds of incorporated national universities for joint research with those incorporated national universities or incorporated inter-university research institutes, the tax on real property acquisitions is reduced to one-half, while the tax base for the fixed property tax is reduced to one-half for the first five years after acquisition, and to three-fourths for the succeeding five years. | Local Tax Law Supplementary Provisions, Article 11, Item 17, and Article 15, Item 24 | Enacted in FY1999 (real property acquisition tax), enacted in FY2000 (fixed property tax) (effective through FY2004) |

(As of April 2004)

### 3.3.1.2.3.2 Promoting Private Sector Research Activities through Investment and Loans

To promote research activity in the private sector, fiscal investment and loan systems for technology development are implemented by various government-affiliated organizations. The following section introduces some of the main examples of this.

#### (1) National Agriculture and Bio-oriented Research Organization

The National Agriculture and Bio-oriented Research Organization was established in October 2003 through the merger of the National Agricultural Research Organization and the Bio-oriented Technology Research Advancement Association, with the aim of promoting experimental research in the private sector concerning the designated industrial technology of biological systems. Using investments and financing from the Industry Investment Special Account and investments from private sources, the Organization provides funds and conditional interest-free loans, as well as referrals for joint research. In FY2003, investments and financing from the Industry Investment Special Account totaled 1.5 billion yen.

#### (2) Organization for Pharmaceutical Safety and Research

The Organization for Pharmaceutical Safety and Research (OPSR) started operating in October 1987 with the aim of promoting experimental research in the private sector concerning medical products technology and similar matters. Using funds from the Industry Investment Special Account and private sources, the organization provides conditional interest-free loans and funds, and encourages joint research activities. In FY2003, funds from the Industry Investment Special Account totaled 1.3 billion yen.

#### (3) Other Financial Provisions

To ensure the development of new technologies recognized as being able to contribute to a major improvement in the level of Japan's industrial technology, the Development Bank of Japan implements the New Technology Research and Development Loan Program to provide long-term, fixed, low-interest loans to corporations for development costs related to new technologies.

### 3.3.1.2.3.3 Promotion of Private Sector Research Activities through Subsidies

A system of subsidies is made available to support research and development aimed at commercialization by the private sector. The main subsidies are as follows:

#### (1) Subsidies for Pharmaceuticals to Treat Rare Diseases

To support research and development on drugs, etc., for diseases that afflict very few Japanese, subsidies are provided for costs related to experimental research for applicable pharmaceuticals, etc.

#### (2) Research and Development Project for Advanced Industries in the Agriculture, Forestry, and Fisheries Industries, and the Food Industry

Subsidies are being provided to promote private sector research and development in the biotechnology sector, and to promote the practical application of exceptional research results obtained at incorporated administrative research agencies.

#### (3) Technology Development Project for the Creation of Collective Private Agribusiness

In order to stimulate agribusiness, support is given for research and development that utilizes the potential of universities and incorporated administrative agencies, and is conducted by private-sector enterprises that assume the task of turning research results into practical applications.

#### (4) Research and Development Project to Create New Enterprises

As part of the Millennium Project, the Ministry of Agriculture, Forestry and Fisheries used joint research groups that bring together private-sector enterprises, etc., to implement research and development toward the realization of functional crops.

#### (5) Program for the Support of Research on the Integration of Different Fields for the Creation of Bio-oriented Industries

Orchestrating the R&D ability of industry, academia, and the government, integrative research conducted by researchers from different fields is implemented with an open invitation for proposals from the public, and the building of partnerships is supported.

#### (6) Technology Developing Project for Strengthening Industrial Infrastructure

To strengthen the technological infrastructure of Japan's food industry, projects are subsidized after themes have been selected based on the evaluations of outside specialists and experts on specific topics canvassed from enterprises, following the government's indication of technological topics.

#### (7) Subsidies for Research and Development of Creative Technologies

From the perspective of technology development and improving the technological capabilities of small and medium-scale enterprises, subsidies are provided for costs related to the development of creative new products, and the research and development of new technologies.

### (8) Subsidies for Cutting Edge Technology Research and Development

The National Institute of Information and Communications Technology (NICT) subsidizes the research and development costs for venture enterprises carrying out cutting edge R&D related to telecommunications technologies that will lead to the creation of new business in the future.

### (9) Subsidies for Research and Development into the Improvement of Communication and Broadcast Services for Elderly and Disabled People

The NICT provides private sector corporations, etc., with subsidies for research and development costs necessary for the development of communication and broadcast services for the elderly and disabled.

### (10) Program for Support (Subsidy) of Technology Development for Creation of New Industries

To support particularly promising research and development from a regional perspective, and to nurture groups of corporations with world-class technologica
l capabilities, subsidies are provided to private sector corporations, etc., for research and development costs related to technology that contributes to the creation of new industries.

### (11) Private Sector Fundametal Technology Research Support Scheme

In order to promote experimental research into infrastructure technologies conducted in the private sector related to the mining, manufacturing, electro-communications and broadcasting industries, public applications are invited for entrustment research contracts. Applications are accepted by the New Energy and Industrial Technology Development Organization for mining and manufacturing technologies, and by the NICT for communications and broadcasting technologies.

### (12) Grants for Practical Application of Industrial Technology

To strengthen industrial technology in the private sector, the New Energy and Industrial Technology Development Organization (NEDO) provides financial support on a cost-sharing basis to private sector enterprises for development of practical new technologies aimed at creating new markets or responding to social needs.

### (13) Subsidies and Consignment Expenses, etc., Conducted under the Small Business Innovation Program

This program is described under the section entitled, “3.3.2.4, Developing an Environment to Invigorate Research and Development-style Ventures.”3.3.1.2.3.4 Other

A number of measures are being implemented to ensure the availability of superior personnel at small businesses, venture businesses, and other corporations that have just started business operations. These measures include the promotion of personnel exchanges between universities and industry, etc., in order to nurture and produce personnel with an entrepreneurial sprit, to implement model research for courses offered on leading entrepreneurship at universities, etc., to further promote internships at venture businesses, etc. (student enterprise experience program), and to encourage university graduates to go into venture business operations.

Additionally, to support the creation of new businesses through entrepreneurial activities within corporations or through corporate spin-offs, a share conversion and share transfer program is being implemented to ensure the smooth reform of corporation organizations through the use of corporate spin-offs and holding companies, etc. In addition, studies have commenced into the development of a legal system for breaking up companies.

The Law for Promotion of New Enterprises is intended to promote the creation of new enterprises that make use of local industrial resources such as technology or personnel, etc., and offer support for business activities that utilize the new technologies of small and medium-scale corporations, for the development of a general support system from research and development through commercialization, and for the development of facilities that promote the expansion of businesses that utilize research results.

In addition, when preparation by the private sector is difficult because of the need for large-scale and joint-use facilities, the national government is prepared to undertake the preparation of facilities and equipment for joint use with the private sector (Table 3-3-7).

## Table 3-3-7 Development of large-scale and expensive joint-use facilities

| Ministry or agency | FY of first use | Facility name, Summary of facility or equipment | No. of cases for private-sector use (Unit: No. of cases) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | FY 1996 | FY 1997 | FY 1998 | FY 1999 | FY 2000 | FY 2001 | FY 2002 | FY 2003 |
| Ministry of Internal Affairs and Communications | 1999 | TAO. Tsukuba Gigabit Laboratory | — | — | — | 15 | 26 | 29 | 55 | 54 |
| | | TAO. Keihanna Gigabit Laboratory | — | — | — | 15 | 28 | 26 | 26 | 14 |
| | | TAO. Kitakyushu Gigabit Laboratory | — | — | — | 12 | 28 | 22 | 25 | 19 |
| | | TAO. Kyoto Gigabit Laboratory | — | — | — | 7 | 8 | 12 | 15 | 7 |
| | | TAO. Okayama Gigabit Laboratory | — | — | — | 7 | 12 | 29 | 18 | 13 |
| | | Shared Use Research Facilities established by the Telecommunications Advancement Organization of Japan (TAO) in five locations around Japan as one part of the "Japan Gigabit Network" for the purpose of early attainment of a very-high speed multimedia society. The facilities are broadly open to corporations, universities, research institutions, municipal corporations, etc., and provide an environment for the implementation of research and development of high-performance applications technologies, etc. | | | | | | | | |
| | | Hokkaido R&D Center | — | — | — | 11 | 12 | 16 | 12 | 9 |
| | | Tohoku R&D Center | — | — | — | 12 | 10 | 20 | 21 | 22 |
| | | Tokai R&D Center | — | — | — | 14 | 27 | 27 | 20 | 21 |
| | | Kinki R&D Center | — | — | — | 15 | 18 | 14 | 12 | 0 |
| | | Chugoku R&D Center | — | — | — | 14 | 14 | 14 | 11 | 8 |
| | | Takamatsu, Okayama R&D Center | — | — | — | 12 | 13 | 13 | 23 | 17 |
| | | Kyushu R&D Center | — | — | — | 14 | 20 | 15 | 11 | 10 |
| | | Shin-etsu R&D Center | — | — | — | 14 | 28 | 27 | 9 | 10 |
| | | Hokuriku R&D Center | — | — | — | 9 | 11 | 12 | 12 | 14 |
| | | Okinawa R&D Center | — | — | — | 11 | 10 | 12 | 10 | 9 |
| | | 10 nationwide open facilities for research and development on digital terrestrial television broadcasting on a practical scale were established by the Telecommunications Advancement Organization of Japan (TAO). Furthermore, these 10 facilities are also connected with a nationwide network relay experimental facility used for local broadcasters, with the participation of wide ranging fields in education, welfare, distribution, publishing, and local public authorities, etc., to provide an environment for the implementation of research and development of new technologies and services. | | | | | | | | |
| Ministry of Education, Culture, Sports, Science and Technology | 1996 | Numerical Space Engine<br>Supercomputer and various servers | 1 | 4 | 2 | 0 | 0 | 0 | 0 | 0 |
| | 1997 | Snow and Ice Disaster Prevention Test Facility | — | 1 | 3 | 0 | 3 | 6 | 6 | 8 |
| | | Completed March 1997. Total construction costs: 1.4 billion yen. Two snow-making devices can generate two types of falling snow, the crystalline and globular types. Also equipped with rainfall, sunshine, and wind tunnel devices, to recreate all possible snow and ice phenomena. Low-temperature test facility: Temperature –35℃ to 25℃ Base area: 24m × 7m | | | | | | | | |
| | 1997 | Synchrotron Radiation Facility (SPring-8) | — | 5 | 14 | 26 | 50 | 62 | 115 | 139 |
| | | The facility construction was carried out jointly by the Japan Atomic Enegy Research Institute (JAERI) and RIKEN-and is designed for research in a wide range of disciplines using synchrotron radiation that is emitted from an electron traveling at almost the speed of light when its path is bent by a magnetic field. Japan Synchrotron Radiation Research Institute (JASRI), which was designated by law as the Organization for the Promotion of Synchrotron Radiation Research, has conducted facility management and striven to promote its public use. | | | | | | | | |
| | 1997 | High Enthalpy Shock Tunnel<br>At 80 meters in length, the world's largest free-piston shock tunnel. Maximum pressure 150Mpa, maximum entropy 25MJ/kg. | — | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | 1998 (*1) | Ultra-Strong Magnetic Field Generating Device (powerful field magnet) | 16 | 16 | 62 | 73 | 70 | 68 | 83 | 87 |
| | | An advanced facility that uses a world–class 40–ton hybrid magnet and various other magnets for study into magnetic field strength, special expansion, precision, and stability, in order to conduct measurements into electronic properties, material properties, etc. | | | | | | | | |
| Ministry of Health, Labour and Welfare | 1975 | Special Gas Explosion Test Device<br>Large-scale pressure-resistant facility for testing the safety performance of explosion-proof electrical facilities. | 15 | 10 | 1 | 0 | | | | |
| | 1982 | Equilibrium Performance Measurement Device<br>Research facility for explicating equilibrium performance in the human body, loss of balance when subjected to external forces, etc. | 1 | 0 | 1 | 1 | | | | |
| | 1988 | Centrifugal Loading Device<br>Research facility for explicating earth collapse characteristics | 3 | 0 | 4 | 4 | | | | |
| | 1997 | Tsukuba Primate Center Joint Use Facility<br>Provides quality monkeys uninfected by specific viruses, to promote health sciences research, including research on gene therapy, longevity sciences, brain and nervous system, and intractable | — | 0 | 2 | 2 | | | | |
| Ministry of Agriculture, Forestry, and Fisheries | 1996 | Building for engineering experiments related to earthquake resistance and comfortable wood construction | — | 1 | 2 | 1 | 1 | | | |
| | | Test facility for seismic resistance of wood structures: Reaction floor, Reaction wall, Actuators (2 units of 300KN, 2 units of 200KN, and 4 units of 100KN) | | | | | | | | |
| Ministry of Land, Infrastructure and Transport | 1997 | Sudden Braking and Increased Vibration Testing Apparatus with Intra-Pier Continuous Girders | — | 0 | 0 | 0 | | | | |
| | | Involves the use of apparatus to conduct research into earthquake-resistant designs of bridges, by using air bearings to float a 32-meter-long intra-pier continuous girder and the entire supporting bridge structure, including bridge abutments and piers, and then running a freely suspended weight across it to collide and come to a sudden stop against a reaction wall, in order to input data about impact acceleration. | | | | | | | | |
| | 1999 | Aqua Restoration Research Center | — | — | — | 5 | 3 | 0 | 2 | |
| | | Researches the preservation of river and marshland ecologies, for the purpose of research and development that facilitates mankind's coexistence with nature. | | | | | | | | |

Notes: 1. Cases of use in FY2002 are for April 1 to December 31.

*1.Outside use based on joint research contacts. Beginning in FY1998, however, research topics were open to public canvassing, with a committee composed of outside experts based at the institute charged with selecting topics.

## 3.3.2 Strengthening of Industrial Technology and Reform of the Structure for Co-ordination between Industry, Academia, and Government

### 3.3.2.1 Promoting Commercialization for the Practical Use of Research Results Achieved by Public Research Institutions

### 3.3.2.1.1 Introduction

#### 3.3.2.1.1.1 Promotion of Cooperation among Industry, Academia, and Government

The 21st century is being referred to as the "century of knowledge." The creation and utilization of that knowledge is indispensable to Japan's future development, for which the cooperation among industry, academia, and government is an important effort. Cooperation among industry, academia, and government in Japan has made great progress recently. For instance, the number of joint research projects between universities and industry has more than doubled in five years. As of the end of March 2004, 1,236 patent licenses had been secured through Technology Licensing Organizations (TLOs)—specialty organizations that transfer the fruits of university research to industry, of which there were 36 as of end of March 2004. In the past three years, over 330 venture companies have been created that utilize the fruits of university research. As of August 2003, there were 654 such venture companies, of which 614 were university-based start-ups. At the same time, however, the acquisition and execution of patents in Japan is not always sufficient, given the world-class R&D capabilities of Japanese universities. The future cooperation among industry, academia, and government must be promoted further, for which various efforts are being strengthened.

#### 3.3.2.1.1.2 Strengthening Intellectual Property Strategy

In July 2002, the government's Strategic Council on Intellectual Property settled on the Intellectual Property Policy Outline. December of the same year saw the enactment of the Basic Law on Intellectual Property. Based on that law, the Strategic Program for the Creation, Protection, and Exploitation of Intellectual Property—which sets out measures that the government should carry out in a focused and planned manner—was drawn up in July 2003. Various measures are being developed along the lines of this program in order to hasten the strategic acquisition and exploitation of intellectual property by universities, which are the fountainhead of knowledge.

### 3.3.2.1.2 Promoting Commercialization for the Practical Use of Research Results Achieved by Public Research Institutions

To encourage the practical use of research and development results obtained at universities, research institutions, etc., the JST offers a series of comprehensive programs covering the identification of exceptional research results, support for patent applications, and support for the commercial development of research results that are difficult to commercialize. The JST actively supports the patenting of research results obtained at universities, public research institutions, and TLOs, as well as other technology transfer endeavors, and also runs the Technology Transfer Support Center, which is responsible for foundational work related to these activities, including the education of human resources and comprehensive consulting on technology transfer issues. Under its Research Results Optimization and Transfer Project, the JST also promotes the following efforts based on the research results of universities and public research institutions: the implementation of a test to pursue the rights to intellectual property for patents relating to research results for which applications have been

filed for basic patents; the modeling of new technology concepts from R&D-oriented medium- and small-scale enterprises; and the formation of venture corporations stemming from universities and public research institutions through the promotion of R&D aimed at the creation of new industries. Furthermore, in collaboration with universities, public research institutions, and TLOs, the JST provides development referrals for, and help with, licensing research results. For research results that carry a particularly large development risk, JST offers the Contract Development Project that entrusts the development to corporations as a way of actively supporting the translation of new technologies into practical applications.

The Ministry of Education, Culture, Sports, Science and Technology supports university researchers who are attempting R&D that links basic research and research for product development—a stage of R&D that has insufficient support and is nicknamed "death valley." The Ministry targets researchers whose research results can be expected to lead to entrepreneurial activities in the future and subsidizes their R&D expenses and the management expenses for preparing a business plan toward the establishment of a business. As of the end of March 2004, MEXT has also placed coordinators in 76 universities nationwide, where they serve as bridges between universities and enterprises that are conducting joint research at the universities. By FY2003, MEXT had prepared facilities (dubbed "incubation facilities") at 23 national universities in support of practical research conducted by individuals who plan to use university research results and personnel resources to start up a venture business.

Furthermore, in recent years MEXT has been promoting the opening of special continuing education courses at universities and educational institutions to create human resources who are experts in both advanced technology and management (Management of Technology or MOT) and those who are experts in intellectual property. To foster human resources who are well versed in the securing and utilization of intellectual property, MEXT itself has since FY2002 been training human resources who will perform specialized jobs in the future at research locations, and equipping them with special knowledge about the securing and utilization of intellectual property as part of the "Fostering Talent in Emergent Research Fields," program, which is supported with Special Coordination Funds for Promoting Science and Technology.
"Program to Foster Talent in Emergent Research Fields,"

At RIKEN, researchers were granted permission to have side jobs, and a program for preferential measures in joint research was established in January 1998, with the aim of more effectively linking researchers' research results to practical application.

The Ministry of Agriculture, Forestry and Fisheries is implementing a Technology Results Transfer Promotion Program for the utilization and practical application of acquired patents by the private sector, through appointing coordinators to serve as a bridge between experimental research institutions and private-sector firms.

The Ministry of Economy, Trade and Industry helps translate university research results into businesses through implementation of the Practical Application Research and Development Program for University-based Business Creation, which supports joint research by making matches between industry and academia with the objective of creating practical applications, and through the Dispatch of Management Experts Program for university-based start-ups. Aiming at the creation of 10,000 MOT personnel, METI has since FY2002 also been promoting the improvement of environments for the cultivation of MOT human resources. It does this by supporting the development of curricula and educational materials needed to cultivate MOT personnel at a total of 73 educational institutions such as universities.

In order to provide the appropriate protection of

research results at national and public experimental research institutions and universities, and to support the smooth transfer of research results to industry, the Patent Agency hosts patent promotion fairs to provide opportunities for interaction with industries interested in adopting technologies. These fairs were implemented in 67 cities nationwide in the period between FY1997 and FY2002. In addition, the National Center for Industrial Property Information dispatches, as of the end of March 2004, patent promotion advisors to the 28 of 36 approved TLOs that are currently in operation, and also dispatches intellectual property management advisors to five universities to support the development of intellectual property management departments. In addition, the Patent Agency sponsors international patent promotion seminars for a broad range of researchers and students from universities and public research institutions, which bring together large groups of individuals who are experts in the transfer of technology both in Japan and abroad. The Patent Agency also implements basic and practical training on patent promotion and technology transfer necessary to promote the transfer of research results to industry.

Furthermore, the Law to Strengthen Industrial Technical Ability, which was enacted in April 2000, provides further policies to support the transfer of technology, such as measures to reduce patent fees, etc., for university researchers and university corporations.

To promote the utilization of research results obtained at national experimental research institutions, national universities, etc., conditions have been set to allow optional contracts for the transfer of government-held patents and for setting exclusive licenses. The relevant institutions were notified of these conditions in December 2000 and again in February 2001, and the result should be a greater return of the fruits of research to society.

### 3.3.2.2.Developing an Environment for the Transfer of Technology from Public Research Institutions to Industry

Public research institutions must clarify the responsibility of institutions and researchers to explain to society the content and results of their research, and must voluntarily and proactively promote intellectual asset rights for research results, rather than solely relying on research papers.

During the period of the First Science and Technology Basic Plan, each ministry and agency, working from the necessity of strengthening incentives to individual researchers, made efforts to attribute patents obtained during working hours to individuals, in order to encourage their utilization. These efforts, however, did not necessarily lead to increased implementation. As a result, to more effectively encourage the utilization of research and development results, patents are now to be attributed to the research institutions, in line with proposals in the Second Science and Technology Basic Plan. Accordingly, the number of preferential licenses extended to private sector organizations resulting from patents obtained through joint research between national experimental research institutions and private sector organizations has increased with every passing year.

To promote close coordination between national universities and local businesses, and to promote vigorous joint research activities, the Ministry of Education, Culture, Sports, Science and Technology is particularly striving to utilize the research capabilities and so forth of national universities. By March 2004, MEXT had promoted the development of centers for cooperative research at 58 national universities, and developed venture business laboratories at 45 national universities that support science and engineering-oriented graduate students. These venture business laboratories are aimed at the promotion of creative research and development that will result

in the creation of new industries, and the nurturing of creative personnel with an advanced level of specialized professional skill.

The Law for Promoting University-Industry Technology Transfer came into force in August 1998, with the aim of pioneering new business fields, improving industrial technology, and revitalizing research activities at universities by promoting the patenting of university research results and the transfer of technology to industry. 36 TLOs have been approved under this law as of the end of March 2004, and 5,058 patent applications have been filed, also as of March 2004, according to an investigation by the Ministry of Economy, Trade and Industry (Table 3-3-8, Figures 3-3-9 and 3-3-10). Moreover, the Industrial Revitalization Law, put into force in October 1999, reduced TLO patent fees by one half. Following the enactment of the Law to Strengthen Industrial Technical Ability in April 2000, TLOs now have the ability to use the facilities of national universities as offices at no cost.

# Table 3-3-8 Approved TLOs (Total of 36 institutions)

March 2004: 36 institutions approved as TLOs, 2 institutions recognized as TLOs

| Name of TLO company | Date approved | | Name of participating university |
|---|---|---|---|
| Hokkaido Technology Licensing Office Co., Ltd. | Approved | Dec. 24, 1999 | Hokkaido University and other universities and colleges in Hokkaido |
| TOHOKU TECHNO ARCH Co., Ltd. | Approved | Dec.4, 1998 | Tohoku University, other national universities, etc., in the Tohoku region |
| Institute of Tsukuba Liaison Co., Ltd. | Approved | Apr. 16, 1999 | University of Tsukuba, others |
| Center for Advanced Science and Technology | Approved | Dec. 4, 1998 | University of Tokyo |
| The Foundation for the Promotion of Industrial Science | Approved | Aug. 30, 2001 | Institute of Industrial Sciences, University of Tokyo |
| Tokyo University of Agriculture and Technology TLO, Co. Ltd. | Approved | Dec. 10, 2001 | Tokyo University of Agriculture and Technology |
| THE CIRCLE FOR THE PROMOTION OF SCIENCE AND ENGINEERING | Approved | Aug. 26, 1999 | Tokyo Institute of Technology |
| Campus Create. Co., Ltd. | Approved | Feb. 19, 2003 | The University of Electro-Communications |
| | Recognized | Feb. 19, 2003 | |
| Technology Advanced Metropolitan Area Technology Licensing Organization | Approved | Dec. 4, 2000 | Tokyo metropolitan area universities |
| Yokohama TLO Co., Ltd. | Approved | Apr. 25, 2001 | Yokohama National University, Yokohama City University, and other universities and colleges in Kanagawa prefecture |
| Niigata Technology Licensing Organization Co., Ltd. | Approved | Dec. 25, 2001 | Niigata University and other universities and colleges in Niigata prefecture |
| KUTLO (Kanazawa University Technology Licensing Organization) | Approved | Dec. 26, 2002 | Kanazawa University and other universities and colleges in Ishikawa prefecture and the Hokuriku region |
| Yamanashi Technology Licensing Organization Co., Ltd. | Approved | Sep. 21, 2000 | Yamanashi University and Yamanashi Medical College |
| SHINSHU Technology Licensing Organization | Approved | Apr. 15, 2003 | Shinshu University, Nagano National College of Technology |
| HAMAMATSU FOUNDATION for SCIENCE and TECHNOLOGY PROMOTION (January | Approved | Jan. 17, 2002 | Shizuoka University and other universities and colleges in Shizuoka prefecture |
| NAGOYA INDUSTRIAL SCIENCE RESEARCH INSTITUTE | Approved | Apr. 19, 2000 | Nagoya University and other universities and colleges in the Chubu region |
| Mie TLO (Mie Technology Licensing Organization) | Approved | Apr. 16, 2002 | Mie University and other universities and colleges in Mie prefecture |
| Kansai Technology Licensing Organization Co., Ltd. | Approved | Dec. 4, 1998 | Universities and colleges in the Kansai region (Kyoto University, Ritsumeikan University, etc.) |
| | Recognized | Jul. 10, 2002 | |
| Osaka Industrial Promotion Organization | Approved | Aug. 30, 2001 | Osaka University and other universities and colleges in Osaka prefecture |
| New Industry Research Organization (NIRO) | Approved | Apr. 19, 2000 | Kobe University and other universities and colleges in Hyogo prefecture |
| Hiroshima Industrial Promotion Organization | Approved | Oct. 09, 2003 | Hiroshima University and other universities and colleges in Hiroshima prefecture |
| Yamaguchi Technology Licensing Organization | Approved | Dec. 9, 1999 | Yamaguchi University |
| TECHNO NETWORK SHIKOKU CO., LTD. | Approved | Apr. 25, 2001 | Universities in the Shikoku region |
| Kyushu TLO Company, Ltd. | Approved | Apr. 19, 2000 | Kyushu University |
| KITAKYUSHU TECHNOLOGY CENTER CO., LTD. | Approved | Apr. 1, 2002 | Kyushu Institute of Technology and other universities and colleges in the Northern Kyushu region |
| Kumamoto Technology and Industry Foundation | Approved | Aug. 30, 2001 | Kumamoto University and other universities and colleges in Kumamoto prefecture |
| Oita Technology Licensing Organization, Ltd. | Approved | Aug. 26, 2003 | Oita University and other universities and colleges in Oita prefecture |
| Miyazaki TLO | Approved | Mar. 16, 2003 | University of Miyazaki and other universities and colleges in Miyazaki prefecture |
| Kagoshima Technology Licensing Organization Co., Ltd. | Approved | Feb. 19, 2003 | Kagoshima University, National Institute of Fitness and Sports in Kanoya, and Kagoshima National College of Technology |
| Keio University Intellectual Property Center | Approved | Aug. 26, 1999 | Organizations on the Keio University campus |
| Tokyo Denki University Center for Research Collaboration | Approved | Jun. 14, 2000 | Organizations on the Tokyo Denki University campus |
| Nihon University Business Incubation Center (NUBIC) | Approved | Dec. 4, 1998 | Organizations on the Nihon University campus |
| NMS-TLO Center | Approved | Feb. 19, 2003 | Organizations on the Nippon Medical School campus |
| Meiji University Intellectual Property Center | Approved | Apr. 25, 2001 | Organizations on the Meiji University campus |
| WASEDA UNIVERSITY INTELLECTUAL PROPERTY CENTER | Approved | Apr. 16, 1999 | Organizations on the Waseda University campus |

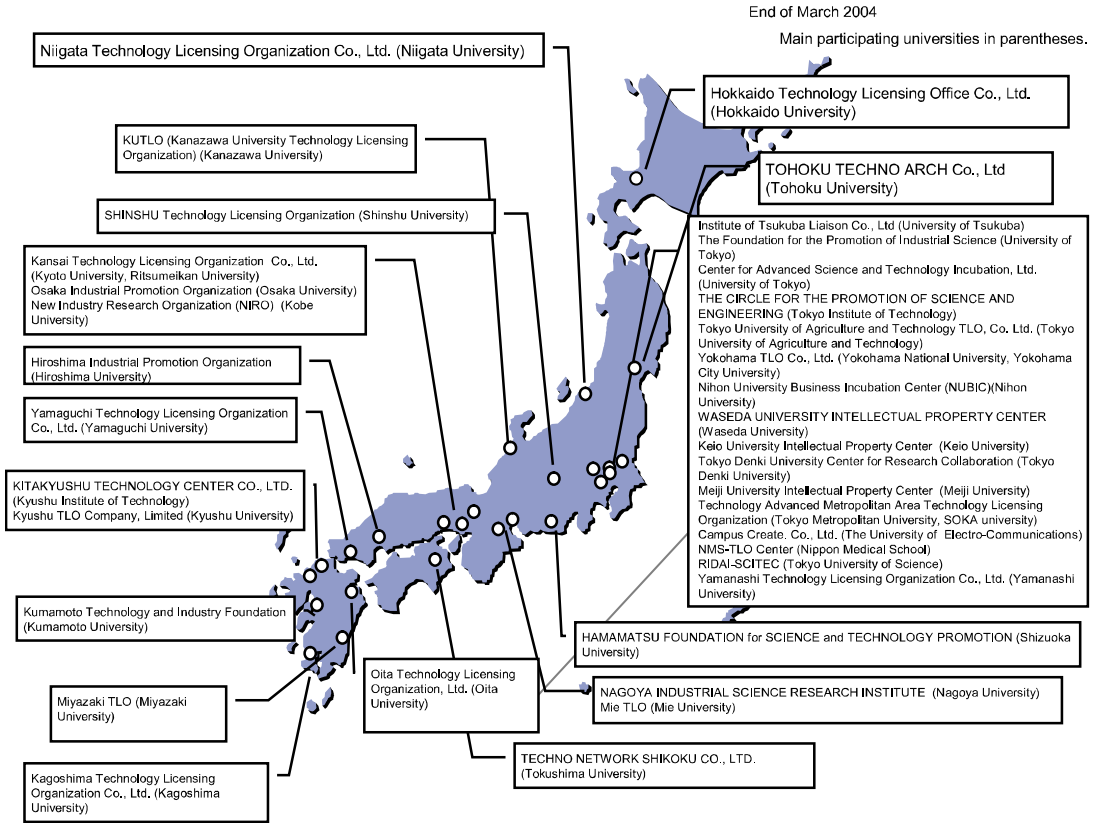


**Figure 3-3-9 Distribution of approved TLOs (36 institutions)**

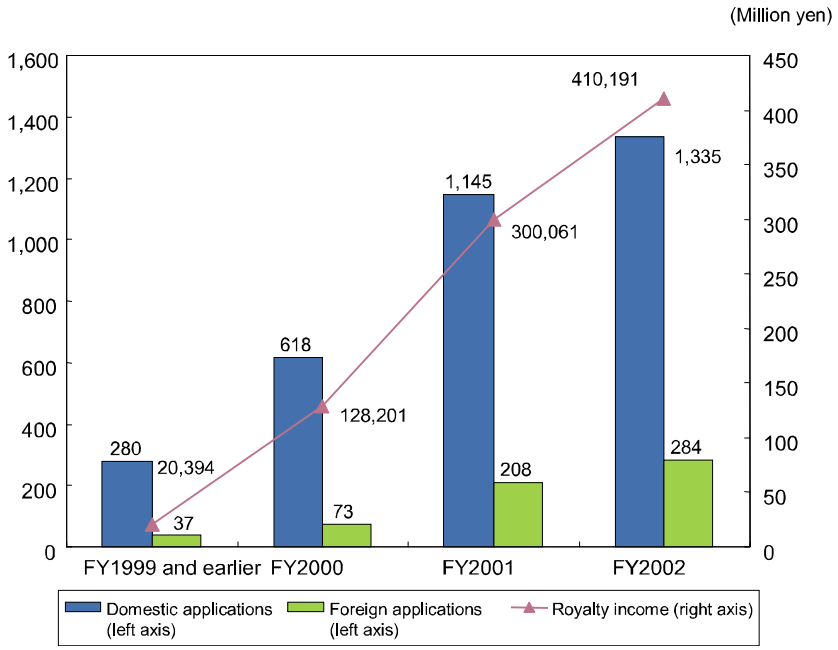


**Figure 3-3-10 Trend in approved TLO patent applications and royalty**

To support TLO activities, the Ministry of Economy, Trade and Industry has issued subsidies to TLOs since the early enforcement stages of the Law for Promoting University-Industry Technology Transfer. In response to the large burden that foreign patent applications are having on TLOs, METI started in FY2003 to help cover foreign application costs with expanded subsidies. Furthermore, METI drew up the "Guidelines for preparing trade secret management policy at universities," to enable universities to manage trade secrets to an appropriate extent under their own judgment, and to facilitate smooth technology transfer of universities research results to industry. The guidelines are being made widely known to university-connected individuals.
Additionally, Article 30 of the Industrial Revitalization Law (the so-called Japan version of the U.S. Bayh-Dole Act) put into force in October 1999, allows the researcher to whom government-sponsored research has been commissioned to fully own patent rights, etc., gained through research. This change is expected to stimulate greater desire to engage in research, and to promote commercialization of research results in the private sector.

Moreover, the Intellectual Property Policy Outline, etc., pointed out the need to support the development of a system that will allow strategic management of the creation, acquisition, control, and utilization of intellectual property at national, public, and private universities. Together with the incorporation of national universities in April 2004, development of such a system will follow the changeover from the current national government or individual ownership of research results patented at universities to organizational ownership as a general rule. Since FY2002, the Ministry of Education, Culture, Sports, Science and Technology has, through an open invitation for applications, selected 34 model institutions for improvement under the project to improve university intellectual property centers, and nine institutions for support under the "Program to Support Distinctive Intellectual Property Management/Utilization functions. (Figure 3-3-11)."

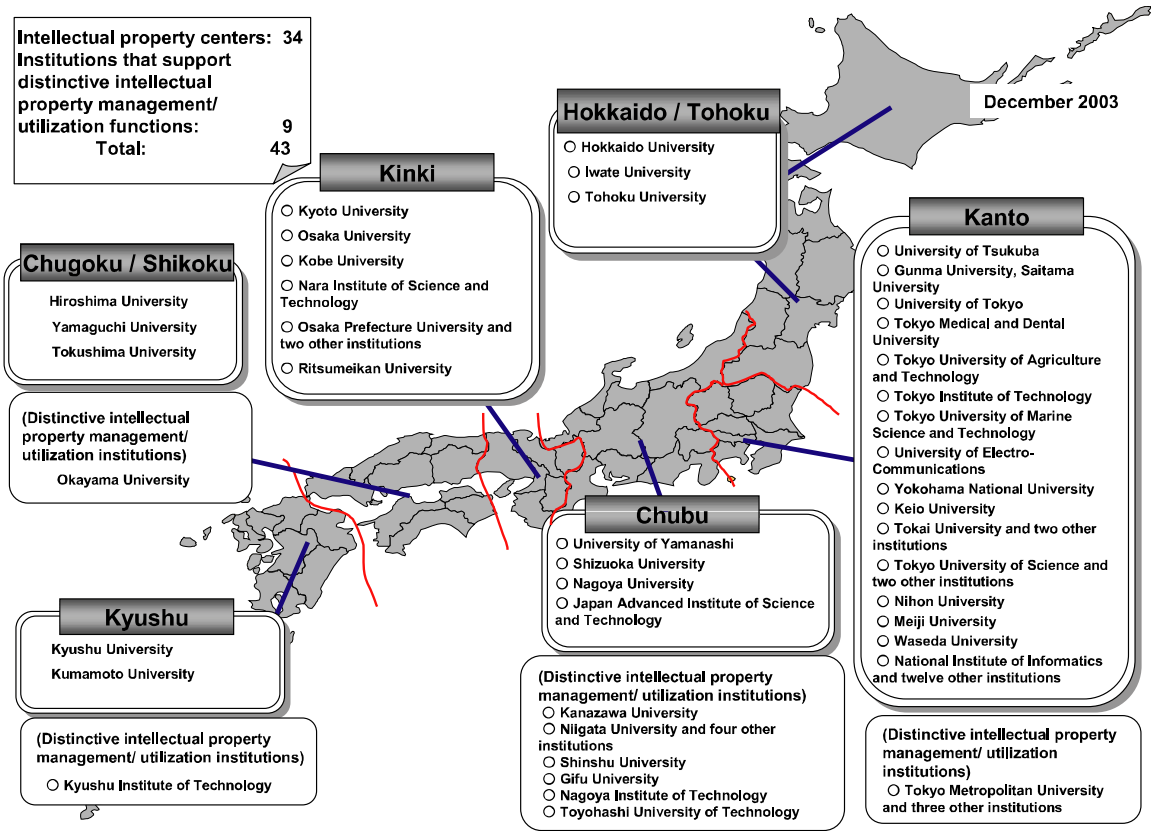


**Figure 3-3-11 Regional distribution of university intellectual property**

Such system improvements can be expected to further propel cooperation among industry, academia, and government, encourage technology transfers, and revitalize Japan's economy through the utilization of the outstanding knowledge produced at universities.

## 3.3.2.3 Reform of Structure for Disseminating Information and Research Exchanges Aimed at Strengthening Coordination among Industry, Academia, and Government

### 3.3.2.3.1 Increasing the Dissemination of Information

To promote the strengthening of coordination among industry, academia, and government, it is essential to bring about a state of common recognition between industry and public research institutions, including universities. For this reason, public research institutions, including universities, are making research results available to the public and providing information in a number of ways, including the presentation of research results, the release of annual reports and other publications, the submission of research papers to various academic societies and journals, and the disclosure of government-owned patents.

To contribute to the creation of new industries, the Ministry of Education, Culture, Sports, Science and Technology utilizes the JST to compile databases covering a broad range of R&D support data and research results data for wide availability over the Internet. Specific examples are the Directory Data-base of Research and Development Technol-